TELEPHONE ENGINEER

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BELL BIDS FOR INDEPENDENT PROPERTY CAUSES COMMENT.

The appearance of the Southern Bell Telephone and Telegraph Co. as a bidder at a receiver's sale of the Consolidated Telephone and Telegraph Co., of Moultrie, has been the cause of a large amount of comment in Independent circles. Coming, as it did, after Independent interests had worked out a plan of sale and reorganization, it appears that the Bell company either considered that the case did not fall within the scope of the "Hall Memorandum" or that this statement of policy should be ignored.

No statement from Bell sources concerning the action of the Southern Bell officials has been made and what went on within the Bell organization is a matter of conjecture. Either the bids were made with or without the knowledge of the American Telephone and Telegraph officials.

If they were made with the knowledge of the parent company it would seem that the "Hall Memorandum" has reached the status of a "scrap of paper."

If they were made without the knowledge of the American Co., it may have been a case where an official of a subsidiary company stepped beyond the limits of the policies of the Bell System.

In either case, the Bell organization should make its position clear, as much of the present stability of the industry and certainly a large portion of the good will that has been built up between the two divisions of the business has been the result of the understandings reached in the Kingsbury Committment and the Hall Memorandum.

HIGH LIGHTS IN THE CINCINNATI RATE DECISION.

Several noteworthy points appear in the recent decision of the Ohio Supreme Court in the case involving rate of The Cincinnati and Suburban Bell Telephone Co. One of the points at issue was the contention of the city of Cincinnati that the amount of the depreciation reserve of the company should be deducted from the reproduction value in order to arrive at the fair value. Reviewing the many decisions on this point, the court held that such procedure was in error and that only the observable depreciation properly could be deducted.

The city's contention seems to be based on the idea, current in some quarters, that the depreciation reserve is, in some sense, a trust fund contributed by the public, upon which a utility should not be allowed to earn a return. The Public Utilities Commission of Ohio had deducted the observed depreciation and its finding was upheld by the court after citation of the various authorities which sanction the rule approved by the court.

Another important point was the claim of the company that the utilities commission had erred in ordering repayment of certain tolls collected under a zoning system. The company has a metropolitan district within which it gives unlimited service at specified rates. It also provides certain local zones in which a subscriber may elect to take service at a lower rate than that for the metropolitan area, receiving service outside of the local zone upon payment of a toll charge. It was the practice of the company to charge tolls on calls which subscribers to the metropolitan rate made to subscribers in the limited service zones. This practice the utilities commission held to be discriminatory and ordered the repayment of such tolls as had been collected from metropolitan area subscribers. The court held, in effect, that limited and unlimited service applies to incoming as well as outgoing calls. The subscriber who chooses a limited service at a lower rate should not be placed on the same basis as another who chooses a greater service at a higher cost. It was, therefore, held that the practice of charging tolls to unlimited subscribers when calling limited service subscribers was a reasonable and lawful practice and not discriminatory. The latter part of the decision will be approved by all telephone men who are familiar with the abuses that occur when free service is given in one direction while a toll is charged in the opposite direction.

SPEEDING UP DURING HOT WEATHER.

During extremely hot weather, ordinary experience is a tendency to let down somewhat in the speed at which things are done. There is a tendency to do things more slowly, or to find ways of

doing them that require less exertion. This results in increased use of the telephone and some abnormal jumps in traffic have been noted.

In New York City, during a recent heat wave, extraordinary measures had to be taken to care for the traffic. Extra forces of operators had to be sent to certain offices and additional trunk lines had to be cut into service. Similar increases were noted in other places and operators were required to work at top speed to keep up with the higher calling rate.

Throughout the rush, the spirit of the operating force was excellent. Many operators volunteered to work overtime and others were transferred to offices some distance from their homes, doing the extra traveling gladly in order to relieve their hard-pressed sisters.

Similar conditions exist, from time to time, in other places than New York and the response of operators to these emergencies always has been worthy of praise. At times, when others have been slowing down or finding easier ways, the operators have been speeding up, and they have done so willingly that the service may not suffer. It is this spirit of service that has made the telephone business of the country unequalled and, at the same time, has made the telephone such an important factor in our daily life.

SOME FACTS ON WOOD PRESERVATION.

With the exception of the farmer, the railroads are the largest consumers of timber in this country. According to figures in Wood Preserving News, fifteen years ago the railroads were using 21,000,000 treated ties annually and these with other timber treated for railroad use amounted to 90 per cent of the timber treated in this country. Today the railroads are using over 60,000,000 treated ties annually but these with other railroad timbers comprise only 80 per cent of the treated timber used. On the basis that a treated tie lasts three times as long as an untreated tie, it is estimated that the railroads saved at least 125,000,000 ties last year.

Although the wire using utilities are not as large consumers of timber as the railroads, yet the annual requirement of over 3,000,000 poles is no small drain on our timber resources. That these companies have not been lagging in their interest in wood preservation is indicated by figures in the recent government report on poles purchased in 1923. Out of slightly more than 3,000,000 poles purchased, 1,527,665 were reported as having received some form of preservative treatment. It is probable that many poles were given brush treatment on the ground where they were set and not reported in the survey.

No extensive investigation is needed to show that the wire companies appreciate the benefits of wood preservation. Any traveler may observe this by checking up the percentage of new poles which have some form of preservative treatment. It is probable, however, that the full advantages are not yet being realized, particularly with cedar and chestnut poles, because the higher grade treatments have not been used as extensively as they deserve. Any form of treatment well done will pay, but the better the treatment, the better it will pay in the long run.

REAR PROPERTY EASEMENTS.

One of the characteristics of modern real estate subdivisions is the absence of alleys. Where the older subdivisions always had one alley, and frequently had intersecting alleys in each block, entire sections of cities now are found where there are no alleys. This, together with general objection to the presence of pole lines on streets, has made the distribution problem for wire-using utilities increasingly difficult.

This difficulty has been met, where the blocks are built up with apartment houses, by installing underground entrances to the buildings nearest the side of the block and working underground from basement to basement. Where the subdivisions are in lots thirty to fifty feet wide and are built up with detached houses, this scheme is not practicable and right-of-way along rear lot lines has been obtained so that the necessary pole lines might be built.

Where such rights-of-way must be obtained, difficulty frequently is met in dealing with the individual lot owners and occasionally work is held up because some one refuses to give the necessary permission to cross his lot.

A much easier way has been found of meeting the problem in advance by providing such right-of-way when the plat of the subdivision is filed. The rear property lines are made subject to an easement for the use of utilities. This gives the right to use a strip one or two feet wide for the purpose of installing the necessary lines. If such an easement is given, the purchaser of a lot gets the property, subject to the easement, and can not obstruct the construction of the lines.

When a new subdivision is opened up, the real estate men usually will be glad to make provision for such easement if the matter is called to their attention. By keeping in touch with active realtors and with engineers who make the surveys for these subdivisions, telephone companies who are following this plan have been able to make provisions for their lines and get their service installed with one of the most economical types of plant—the short pole and all cable distribution on rear lot lines.

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Toll Traffic Efficiency

How Good Working Conditions, Properly Trained Employes, Scientific Analysis of Results, and Enthusiasm Created by Interested Management Contribute to Maximum Efficiency

By W. E. HUTCHINS,

(Commercial and Traffic Superintendent, The United Home Telephone Company, Muskegon, Mich.)

The word "Service" has been printed in all sizes and kinds of type and has been waved before the public eye on all occasions; each letter of the word has been picked to pieces until the term hangs in festoons, and each day finds those of us who are engaged in traffic work, still making more and more shreds of it, and yet many times fail to produce a finished product. Why? Is it because we realize that to attain 100% is impossible or is it because of methods employed? Whatever the reason, there should be a concerted effort to reach as high a percentage as possible, even in the smallest exchange.

A plant in good condition is one essential and a good organization is another. By a good plant is meant, substantial construction, proper maintenance and modern long distance equipment, employing the least possible effort on the part of the operator. By a good organization is meant, that those in charge should be perfectly familiar with traffic operation, selected for their ability to cover the requirements of traffic routine, with the thought kept in mind that only those who are interested enough in the work to remain a reasonable length of time in the service should be employed, eliminating those who desire to make the work a stepping stone only.

Proper study of conditions should constantly be made to determine in what positions all employes will produce maximum results.

Working conditions must be made pleasant and the housing comfortable and sanitary.

Whether the operating room should be made a workshop or have some of the pleasantries of a home is a debated question, but it is evident that a touch of color here and there tends to make a more pleasant disposition which is so essential in the trials of traffic performance.

We talk of the "voice with a smile," and yet we find some exchanges so equipped and working conditions so unbearable that if one really possessed the disposition to smile, it would require some effort to do so.

Interest of Employes Is Essential.

The real thing necessary to attain success in traffic work is to have all employees interested in the work, and this can not be accomplished unless each one has a thorough knowledge of the operating routine. Having this knowledge not only lessens the burden of the work, but produces better results than without it.

With the new Toll Reference and Text Book simplified as it is, there is no reason why all operators, even in small exchanges should not have a complete knowledge of operating routine. If the exchange is small, the Socratic method of teaching may be employed. Questions pertaining to operating methods employed made be made for these exchanges by means of a mimeograph and regularly sent to these exchanges for study. After each question a reference may be made as to where in the text the answer may be found and this will result in a large number of questions by the employee on matters not well understood. This then gives the students an opportunity of applying these instructions and "learn to do by doing."

A Suggested Form of Efficiency Record.

A daily efficiency record of each employee should be kept and reports should be made to the employees at the end of each week. The form usually employed is shown below.

No.		No.	
Name		Name	
Week Ending.....	192	Week Ending.....	192
Absence	5	Absence	
Tardiness	5	Tardiness	
Discourtesy	10	Discourtesy.....	
Phraseology	5	Phraseology.....	
Conversation with Operators.....	10	Conversation with Operators...	
Conversation with Subscriber....	10	Conversation with Subscriber...	
Inattention to Signals.....	10	Inattention to Signals	
Care of Equipment	10	Care of Equipment.....	
Team Work	5	Team Work.....	
Ticket Errors.....	5	Ticket Errors.....	
Tone of Voice.....	5	Tone of Voice.....	
Insubordination	20	Insubordination.....	
per cent.		per cent.	
.....	C. O.		

It is not the purpose to use this record as a means of fault-finding, but rather it should serve to point out the errors of the past week, and by this means assist the employee to make an effort to eliminate such errors as have been previously made. Neither is it supposed that a chief operator or the supervisors will note all errors made, but they will be able to secure enough data each week to determine the efficiency of the employee, and to enable the weak places to be strengthened, thus giving the employee a better understanding of the work and thereby creating a greater interest.

The delivery of the efficiency reports each week is generally looked upon with eagerness and employees are permited to ask questions pertaining to the errors noted thereon.

When the above method is scrupulously carried out and the purpose well defined, it is remarkable to note the increased efficiency in the work and the interest manifested by those engaged in it.

Daily Toll Analysis

One of the most important studies of long distance traffic is the daily toll analysis. This form shows the number of calls offered, the number of completed messages, the number of calls lost and the code reason. This is made up daily for the entire month and the report sent to the General Office at the close of the month. The percentage of completed business is found and a report of all exchanges sent to each exchange. The rivalry created is little less than marvelous.

In making comparison of these percentages, exchanges should be grouped according to the amount of business handled either from a traffic or revenue standpoint as well as the volume of business or traffic on long or short haul. At the close of the year, an annual report should be prepared for each exchange, showing the monthly percentage of each exchange, the monthly territory average, and the percent of completed business for the territory.

This means of looking the traffic situation squarely in the face does one of two things:—we are operating with a satisfactory efficiency or we have failed.

A well known Michigan Company operating under this method in 1924 shows a completed percentage of 94%,

and the employees are unanimous in requesting its continuance.

Another necessary study of traffic is the holding time of calls.

A satisfactory completed percentage does not necessarily mean that an entirely satisfactory service has been rendered, but the two studies do determine this to a certainty.

Frequent studies of the holding time of calls should be made in order to determine the speed of service. This may be studied for a period of a month and the study should show at least four groups, viz: 1 to 10 minutes, 11 to 20 minutes, 21 to 30 minutes and 60 minutes.

Some of us are prone to avoid such studies feeling that we are employing too much "red tape," but no traffic organization can afford to disregard such studies, for in making them, we are only doing what all modern businesses are doing—analyzing scientifically—looking the situation squarely in the face.

One cause of mediocre long distance service is often found in the fact that we do not permit employees to assume enough responsibility. It is natural for us who have had a greater amount of experience to carry the heavy load and permit those under our supervision to stand by and look on. We are somewhat like the plumber who after working an hour on a job gave his helper the unburned portion of the candle to blow out.

The study of completed business in connection with the holding time study provides a graphic picture of the work accomplished and vividly portrays our failures. It may be the means of better training, better circuit plan or may call for additional circuits made necessary by an increased load.

The company referred to in this article as completing 94% of all business offered shows a holding time of 75% in ten minutes or less and 25% in 20 minutes or less, using approximately the same facilities as in 1918 with a traffic load increase of almost 100%. How was this accomplished? The answer may be found in these facts: proper training; scientific analysis of the daily results; holding time study and honest efficiency records regularly in the hands of each employee; change in methods to meet new conditions, enthusiasm displayed by those in charge, smiles, pleasant voices, courteous treatment of fellow employees and the public to the extent of inspiring its confidence, thus securing proper co-operation —these things, together with adequate facilities make up the answer to as near perfect results as we may hope to attain.

Coming Conventions—Indiana, Indianapolis, Claypool Hotel, Sept. 23-24; United State Independent Telephone Assn., Chicago, Sherman Hotel, Oct. 13-16.

Our Literary Digest

Review of Recent Publications on Telephony and Allied Subjects

Audel's Handy Book of Practical Electricity, by Frank D. Graham. Theo Audel & Co., New York.

It would be difficult to think of any branch of application of electrical science that is not touched upon in this practical reference book. It has two vital essentials of a compendium of information, simplicity and brevity and combines with these accuracy. The telephone man will be interested in the sections on telephony but he will find information on almost any other electrical topic into which his work occasionally takes him. It would be impossible in a brief review to attempt to enumerate the subjects covered. Profusely illustrated with hundreds of drawings and engravings it conveys the information with as little effort on the part of the reader as it would seem possible to give. As a timely and helpful handy book of wide utility it deserves a large sale among practical telephone men.

An Outline of Automatic Telephony by William Aitken. Ernest Benn, London.

Little is needed in recommendation of this small volume beyond the name of the author whose monumental work in three volumes is the most complete treatise on automatic telephony now available. While the larger work may be found in technical libraries and in special libraries of engineering schools, its cost has placed it beyond the reach of the ordinary man interested in automatic telephony. The present book gives in small compass and at a reasonable price an introductory description of the automatic telephone systems in use today which will meet the need of many and which will serve the student as an outline which may be supplemented if desired by readings from the larger treatise. The same system of "bus-routing" on circuit diagrams is used which not only effects a considerable saving of time but also establishes a connection between the two books. The telephone man beginning his study of automatic telephony will find no better book with which to commence.

History of the Telephone and Telegraph in Uruguay, 1886-1925, by Victor M. Berthold, published by American Telephone and Telegraph Company, New York.

Dr. Berthold has contributed another of his interesting series of monographs on the development of the telephone in Latin-America. It is no small undertaking to follow the tangled web of telephone and telegraph history through the various changes in this formerly politically unstable country but a fairly complete and consecutive story is the result of the research of the author. Governmental incompetence and lack of political stability show clearly their effects in the resulting lack of growth. Only in Montevideo, the capital city, has there been anything like consistent growth and that only in recent years due to the persistence of the British controlled Montevideo Telephone Company in spite of the difficulties of every description including strikes, governmental interference and the constant threat of nationalization. An interesting chapter of the monograph contains the story of the South American ventures of that brilliant and unstable genius of the early days of the telephone, Frederick Allen Gower, who today is little known to telephone men in the country of his origin, the United States of America.

Pasco County (Fla.) Company Plans Enlargement

Dade City, Fla.—Contract for the erection of the new building for the Pasco County Telephone Company has been let. The contractors will have the building completed within a short time. Plans for this building call for a two-story structure of either brick or concrete construction.

With the completion of this new building, a new switchboard, of sufficient size to care for not only the present business of the company, but allow for the constantly increasing demand for more phones, will be installed. Practically the entire system of lines operated by the Company will be rebuilt, copper circuits replacing the ground circuits now in use, and new cables being installed to care for the many new lines which the growth of their business demands.

National Carbon Opens Pittsburgh Branch

Pittsburgh, Pa.—Rapid increase in the demand for Eveready products in the Pittsburgh territory has led the National Carbon Company to establish on June 15 a new district sales office and warehouse at 600 Second avenue, Pittsburgh, which will carry complete stocks.

The new district will be under the direction of W. H. Haile, District Manager, and R. P. Tolles, Assistant District Manager, who will have charge of the region comprising Ohio, West Virginia, the eastern portion of Kentucky, the western portions of Pennsylvania, New York and Virginia, and the two most westerly counties in Maryland.

Farm Paper Ad Plan Gets O. K.

Illinois and Minnesota Association Officials Among Authorities Endorsing Suggestion to Tell Telephone Company Case to Farmer—Independent Chief Has "Hunch"

Farm paper advertising as a help in solving the rate problem of the smaller telephone companies apparently has strongly impressed many of the foremost students of the small company situation. Following the suggestion of such advertising, in an editorial in the June TELEPHONE ENGINEER, a number of prominent telephone men have commented on the idea.

Jay G. Mitchell, secretary of the Illinois association regards the suggestion as highly "timely and constructive." Mr. Mitchell goes into the situation in his usual incisive fashion by stating:

Smoothen Inevitable Raise.

"In the June issue of TELEPHONE ENGINEER on page 16 appears an editorial entitled "Advertise in Farm Papers." This editorial drags out of the obscurity a remedy for a situation which is extremely serious and which is extremely important to the entire telephone industry under present conditions.

"The effect of Commission regulation of public utilities, and particularly of telephone companies, has been effective in bringing to the companies themselves a realization which might have remained in obscurity otherwise. The theory of Commission regulation, when fully developed, requires that service shall produce revenues sufficient to cover the cost of furnishing the service plus a return to the capital required. It does not require a very extensive study to realize that the ultimate result is to be a readjustment of rates received for any particular grade of service sufficient to cover the costs of rendering such service plus a reasonable return upon the investment required.

"In other words, the service furnished to rural subscribers must supply its own sustaining revenues or a discriminatory condition is created which is inequitable, illogical and economically unsound. The present cost of constructing a metallic rural telephone system is not far from $160.00 per station. The cost of constructing a metallic rural telephone system twenty-five years ago was very much less than that. Assuming for the moment that the rates for rural service were adequate in the beginning, twenty-five years ago, and that the original plant must now be rebuilt, it is obvious that the original rates are now inadequate. These are the conditions which confront the telephone companies.

"The rural community is fair, is honest, and is in fact the backbone of the American nation. The rural community is organized and is tremendously powerful politically and economically. It would seem that the telephone company which fails to place the facts regarding its plight in connection with the furnishing of rural service before its rural subscribers is derelict in its duty to its stockholders and to its subscribers other than those served by the rural plant. We have always advocated the use of continuous, consistent and regular newspaper publicity by telephone companies. Five years ago the author made an address at a district convention at Bloomington, Illinois, which was largely quoted and which advocated the use of paid newspaper space by telephone companies. This address was commented upon in the *Inland Printer* in the issue of August, 1921. There is no reason why the statements made at that time should not be made in a stronger way at the present time, and constructive, carefully prepared advertising at the regular rates should be authorized by every telephone company in its own territory and suitable arrangements should be made so the industry as a whole may use space in the agricultural papers of the nation. These papers are of national circulation, and the rural subscribers of telephone companies read them very widely.

"Your rural subscribers are entitled to the facts in regard to your business, because the telephone service is, if anything, more essential to the rural subscriber than it is to the urban subscriber, and the factors which affect adversely the quality of service that he may receive should be placed before him, and one of the principal factors that affect the quality of rural telephone service adversely in the impossibility of maintaining adequate service under existing rural rates.

"By all means make use of the agricultural papers as well as the local papers, because the most effective way to place the facts regarding your business before the people who pay you your revenues is through the newspapers, and the newspapers should be patronized consistently and regularly in a local way, and the agricultural papers should be patronized consistently and regularly in a national way."

Minnesota Plans Action.

In Minnesota, where the state association has been giving considerable high-powered attention to winning of farmers' good-will, the suggestion for use of farm paper advertising has been well received. J. C. Crowley, Jr., Secretary of the Minnesota Telephone Association, intends to have the suggestion threshed out at the district conferences. In telling of this plan, and of another logical effort the state association intends to make to reach the farmers of the state, Mr. Crowley says:

"I propose to use this editorial, calling our companies' attention to the same during our district conferences. Some concerted effort along these lines must be adopted by the various State Associations; and in addition to same, the employees and representatives of the Independent companies must carry the message personally to their respective communities.

"We in Minnesota proposed to put on something in the way of publicity at each one of our County Fairs to see what can be accomplished in this way. As yet, I am not prepared to disclose just what I have in mind in regard to this County Fair publicity. The plan must be well thought out and the details carefuly checked; and when we have concluded this work we are satisfied that it will meet with the approval of the telephone representatives of this state."

Uniform Publicity Needed.

President F. B. MacKinnon of the United States Independent Telephone Association doubts that the collection of an advertising fund is practical. He believes, however, that much may be done by uniformly planning the publicity to be used by the Independent companies in telling their subscribers of the problems and requirements of the industry. In Mr. MacKinnon's statement he advises:

"I can not quite see where such a suggestion can be acted upon. All of our companies who are operating exchanges in the smaller towns are in touch with the real situation and are making use of their papers. It is not practical to collect a general fund for general advertising in so-called 'farm papers'; but few of our companies would contribute to such a fund

"I think the really valuable part of the plan is unexpressed. What we need is a uniform plan of publicity which all of our companies can use in discussing the telephone situation. Such a plan is being discussed but along what lines it can be worked out I am somewhat in doubt."

Plan's Success Forecast.

Marco Morrow, president of the Agricultural Publishers' association, who is considered one of the foremost authorities on farm paper advertising, has the following comment to make on the proposed telephone farm paper publicity:

"I have read with interest the editorial 'Advertising in Farm Papers' in your June issue. It is timely and suggestive.

"The general public—urban and rural alike—takes the telephone, and other modern untilities, as matters of course, in the same manner as they accept sunshine, fresh air and rain. And they grumble about the weather and the telephone service in the same breath and in the same thoughtless spirit. Because they don't understand. Nor can they be expected to understand unless they know what it's all about. Amiable public relations can exist only where there is a clear understanding based upon information.

"It certainly would seem the part of wisdom for the telephone industry to 'sell' itself to its rural subscribers. American people are fair-minded. They will pay for service cheerfully if they understand the why of the cost. The only way, in the opinion of this observer of human events, in which rural service can ever be improved and rural rates increased to a point where improved service is possible, is via education. Tell the people your problems and the people will help you solve them. And incidentally remember that the only economical and effective way of reaching the farmer is through the agricultural press."

Bell Pioneers to Meet at Washington, Oct. 16-17

Washington, D. C.—Washington has been selected as the place of the Nineteen Twenty-five meeting of the Telephone Pioneers of America.

This is the first general meeting of the Pioneers in Washington, although they have made several stops there on their trail to and from other meetings. The program has accordingly been arranged to give ample time to enable the members and their guests to visit the many points of interest in and about the city.

Head quarters will be established at the Mayflower Hotel, where all sessions will be held and as many of the Pioneers as possible accommodated.

The members of Alexander Graham Bell Chapter No. 15 will be the Hosts and are organizing local committees to cooperate with the National Secretary in making arrangements for the meeting.

All applications for reservations and requests for information will be handled by the National Secretary, R. H. Starrett, and should be addressed to him at 195 Broadway, New York, N. Y. All requests for reservations must be in his hands not later than October 1.

The capacity of the Mayflower Hotel is about 600 guests. It will be impossible to accommodate at this hotel all those who will be in attendance and arrangements have therefore been made to reserve rooms at the Mayflower for the members of the General Assembly and the members of their immediate families accompanying them. After rooms have been reserved for this purpose, other Pioneers and their guests will be assigned to the Mayflower, up to its capacity.

A special rate of a fare and one-half for the round trip has been secured from the various railroads, on the Identification Certificate Plan.

Illinois Association Tackles Transmission Problems

DeKalb, Ill.—The June district conference of the Illinois Telephone Association was notable because of the great interest and excellent program and because of the novel plan followed by the Association in the arrangement of the separate conferences. At the executives' conference J. C. Joslyn, Secretary and General Manager of the DeKalb County Telephone company stressed the importance of cultivating the interchange of ideas between the executives of telephone companies.

A very able presentation of the value of membership in the Illinois Telephone Association was given to those present by Vice President A. R. Patterson, of Streator, who presided at the conference in the absence of President F. A. Norris of Monmouth.

A talk on "The Operating results of Present Telephone Rate Schedules in Illinois" was given by Jay G. Mitchell, secretary-treasurer of the Illinois Telephone Association. This talk was based upon an analysis of the 1923 reports filed with the Illinois Commerce Commission by the telephone companies of the state, and was illustrated by diagrams thrown on the screen by stereopticon. An interesting and profitable discussion of the entire subject followed.

At the operators' conference a number of interesting papers were presented.

At the joint conference the following program was presented:

"Local Operating," Mrs. Katherine Johnson, Park Ridge, Illinois.

"Contributions of Women Employes to the Public Relations of Public Utility Companies," Miss Theresa Carroll, Springfield, Illinois; "Co-operation Between Manager and the Traffic Department," T. F. Sargent, Auditor, DeKalb County Telephone Company; "The Application of Boy Scout Ideals to Plain Telephone Operating," Mrs. Ida Van Arsdale, District Toll Instructor, Illinois Bell Telephone Company.

Robert F. Hallenberg, Director of Public Relations of the Illinois Northern Utilities Company, Dixon, Illinois, spoke on "The Value of Telling the Public Utilities Story."

Announcement was made by the officers of the Illinois Telephone Association of the establishment of a Department for the handling of transmission problems in charge of a permanent member of the staff of the Association's office. The services of this Department are to be available to member companies on the same basis as the services of the head of the Association's Traffic Department are available.

Diamond-Watrous Hot Galvanizing Process Available

New York City.—Licenses to the Diamond-Watrous hot galvanizing processes now are available to selected companies, and subject to certain restrictions, advises the Diamond Expansion Bolt Co., controllers of the new process.

Operation of the process involves placing in perforated baskets of articles to be treated, these baskets being lowered into the molten zinc in the galvanizing kettle, remaining for a brief period until the material has reached the temperature of the molten zinc. Baskets containing the articles being treated then are subjected to compound centrifugal-planetary motion while the coating is still in a fluid or semi-fluid condition.

Among advantages claimed for the process are:

"First, the large amount of spelter which is cast off the article is again used in the kettle. The remaining coating of zinc is so evenly and thoroughly distributed as to give a more permanent protection against rust than was formerly had with the denser coating less evenly distributed. The saving in spelter alone will amount in most cases to more than the royalty paid

"Second, the tonnage increase per day of material that can be coated by this process over the tonnage that can be put through by hand is more than sufficient to offset the royalty. This is especially true of small castings and other light material that requires wiring in bundles under the hand method.

"Third, the high quality of the galvanizing on finished surfaces, threads, etc., eliminates the necessity of further machine work, re-cutting of threads, etc., after galvanizing has been done. This results in an additional very material saving.

"Fourth, the elimination of stickers which in the ordinary course of events must be rehandled by either knocking apart or re-dipping, and through such elimination or passing out of galvanized articles with uneven coating or bare spots is obviated, and the cost of inspection for such defects is avoided.

Staking the Pole Line

The Preliminary Work of Locating and Staking the Pole Line That Is Under Construction or Being Rebuilt Is Important as the Building—How It Is Done

By JOHN M. WALSHE

When building a toll line for open wire, the route and class of construction, together with the specifications to be used, are supplied to the foreman charged with the work.

If possible, this foreman should travel over the entire route and note particulars of every mile. This should be done before any work is started. A note-book should be used and each mile should have a page to itself numbered: mile one, mile two, etc. In each mile notes should be made of the following:

(1) Number of each size of pole required.

(2) Number and kind of anchors, with stub, without, etc.

(3) Number of road or private crossings, giving names.

(4) Number of railway crossings, with measurements of necessary span, clearance over rails, clearance over telegraph lines, distance of poles from rails, distance of poles from telegraph lines, stating double or single track, angle of crossing and any unusual particulars.

(5) Number of long spans, extent of bush cutting necessary (if any), notes on grading, guying and other matters not mentioned above.

When travelling over the route, inquiries should be made about the following matters: Teaming, hauling, stabling, board, lodging, supply of labor, storage facilities, proximity of spur or side tracks and any other services which may be required, such as the location of a blacksmith and a garage. These items may not always be all necessary, as some may be supplied, but knowledge of the ground and conditions to be met is always a great help.

Determining the Equipment Needed

It will now be possible to order the correct amount of material to be shipped to each point. The first operation in building a line is the "staking," which is locating the positions in which the poles are to be placed. For this two men are required; for distinction, call them A and B. They will require the following equipment:

1. Horse and buggy or small automobile.
2. Tape measure, 66 or 100 ft.
3. Flag pole, 2 in. x 2 in. x 16 ft., sharpened at one end and carrying a flag at the other.
4. Coil of iron wire as long as the average span.
5. Sighting rod, 10 ft. long and about one and a half inches in diameter.
6. Hand axe.
7. Stakes, which may conveniently consist of 1-ft. lengths of building lath, sharpened at one end.
8. Checking pencil.
9. Specifications and plan of route.

Starting and Running the Line

On arrival at the place from which the line is to start, the first matter is to find a survey mark. A little experience in locating these is desirable, as the mark may be anything from a tree, to a pile of stones. The survey mark serves to locate the line between the road and private property. Usually, the specifications will call for the pole line to be out in the road. Measure this distance from the survey mark and erect the sixteen-foot flagpole here. The position of the first pole along the line from the flag pole is next measured with the tape. A stake is then taken and two numbers are written on it: the depth of the hole, and the length of the pole to be erected. These are to inform two men—the one who digs the pole hole, and the man who hauls the poles and distributes them. This stake is now inserted loosely in the ground as a mark for the first pole.

On consulting the specifications it will usually be found that the first span will be a short one. This now is measured and a marked stake is placed here. As all the stakes are marked with the depth of hole and length of pole, it will not be necessary to mention this again.

The next span will be of the standard length, according to the number of poles per mile in the class of line under construction.

To Find the Length of a Standard Span

If the line is built in one mile sections, terminating fifteen feet from each end of each mile, and with a short span at each end, it becomes necessary to subtract these trimmings from 5280 feet and divide the result by *three* less than the number of poles per mile. If the line is built in two-mile sections, the same procedure is followed.

If only one short span is inserted at the beginning, the standard span is not affected by it but consists of the quotient obtained from dividing 5280 by *one* less than the number of poles in a mile of that class of line.

This rule results from the fact that it requires three poles to support two spans.

The iron wire is now uncoiled and a standard span is cut off. Allow six inches at each end to turn back and twist up for a handle for the men to hold.

The staking may now proceed as follows: "A" is provided with the number of stakes required for half a mile, less the two already in the ground. "A" now takes hold of one end of the standard span of wire and walks forward, pulling the wire along the ground. "B" carries the ten-foot rod and, holding the other end of the standard span, walks after "A." The wire is kept tight between them. Each time "B" reaches a stake, he pulls on the wire and stops "A," who erects a stake and then walks on.

When "A" has erected his last stake, the next survey mark has to be found. If there are an even number of poles in the mile, it will be half a span ahead; if an odd number of poles, it will be opposite "A's" last stake, as he should take the odd stake in his half mile of them, for this purpose. From this mark, the correct distance of the line from the edge of the road is measured and marked. In case of an odd number of poles per mile, "A's" last stake is erected here. The last remarks refer to the case of a line built in mile or two-mile sections.

Lining Up the Stake

The stakes have next to be "lined in" as follows: "A" now stands with this mark or stake between his heels and, facing the beginning of the line, should see the flagpole at the survey mark half a mile back.

"B" now holds his ten-foot rod upright at the stake nearest "A," and in line between "A" and the flagpole, for "A" to "line in." If the rod held by "B" is not correctly located, "A" raises his right or left arm to inform "B" who moves the rod accordingly to the right or to the left. "A" raises and drops both arms together as a signal to "B" that the location is correct. When "B" receives this signal, he moves the stake into the hole in which his ten-foot rod was "lined in," and drives it in securely.

Both men now move toward the beginning of the line in this way. As the men return, "lining in" the stakes, they also perform another very important operation, that of grading. This was partly done when the length of the pole was written on the stake but alterations in the spacing are also required, to avoid water, depressions, hillocks, roads, gateways, other wires, and sometimes buildings. When a stake is moved to avoid any obstacle, the length of the span, of course, is altered.

The distance it is permissible to move a pole to clear obstructions is determined by the longest span allowed in the specifications. In case any unusual construction not provided for in the specifications is necessary, the engineer is consulted. When the route has been travelled, as advocated earlier in this paper, any extraordinary construction necessary in any particular place will be taken care of by the engineer, the necessary instructions issued at the same time and attached to the route map. Or, the map itself may have such details on it, if they are not too voluminous.

Lining Up Where Flag Is Invisible

There are some cases where staking is not such a straightforward process, as described above, and these are dealt with below.

In cases where it is not convenient to stake on the line where the poles are to be set, and a good road is provided a few yards away, it becomes cheaper and easier to stake the line out as if it was to be built at the edge of the road. Then, after all stakes, anchors and stubs have been located, move all the stakes in the same distance, and they still will be in line. This is called "offsetting."

In hilly country, it may not be possible to see the flagpole from half a mile away. If it is possible to lengthen it sufficiently this should be done; otherwise, it will be necessary to "back stake." In this process, two flagpoles are erected, one at the third from the last and one at the last stake of the preceding section, which has been lined in. The spans of the hilly section will have been staked as no difficulty will be found here. It is now "lined in" by moving its stakes till they are in line with the two flagpoles. When a point is reached from which it is not possible to see the two flagpoles, the two flagpoles are both moved to the end of the completed part, keeping them spaced two, or three spans if possible. If only one hill is in the way, it is only necessary to back stake to the top of it where the flagpole will be easily seen. These methods are not so accurate and, being also more laborious, should only be used when absolutely necessary.

Having reached the place from which they started, the stakers now stake the necessary anchors before removing the flagpole as it is required for this purpose. Anchors are staked with five stakes, four at the corners and one where it is desired to have the eye of the anchor rod. The depth should be written on one of the stakes. As a rule, log anchors are rather more costly to install than patent anchors. The specifications will decide which to use in every case. Only the eye need be staked where patent anchors are used, as no excavation is necessary.

The tops of the poles in each straight section of line are in line, this includes corner poles which may be "raked"; that is, given a lean back on the line and "set in" as well. "Set in" means that the butt is given a "kick in" of a foot or two towards the line with which it is making the corner. This is to strengthen the corner, as is raking. In any case the head guy will be in line with the tops of the poles and, therefore, the eye of the anchor rod can be staked as if it were an additional pole.

The distances at which it is permissible to set the anchor from the poles constantly differ, so that the anchor rod will slope more the greater the distance away from the pole. This means that the excavation will be further from the eye of the rod.

There is a quite simple way of determining the distance; also, the correct depth for the excavation without any mathematics. Draw it to scale, then measure the distances and convert them into feet. Draw on a sheet of paper the pole, ground line, guy, anchor rod and anchor log, all in place, using a quarter of an inch for each foot. Draw the excavation undercut for the log, then measure how far it is from the eye of the anchor rod and how deep the excavation is.

Florida's Great Growth Shown by Hollywood's Rise

Hollywood, Fla.—Hollywood, two years ago only a seven mile stretch on the Florida coast, has not only made a phenomenal record in building a city, but has built for further development. One indication of the way things are going in this amazing land is apparent in the work done at the Hollywood telephone exchange, owned by the Broward Utilities company, and managed by H. N. Fairbanks. Mr. Fairbanks says:

"We will have installed on September the first, six positions of a 4,200 line Western Electric switchboard and are now installing the aerial and underground cables, which amounts to approximately eight miles, six miles of which is 200 pair or larger. We are planning on 1,500 station for this year alone, but our facilities are flexible enough to accommodate double this number in 1926."

Vermont Re-Elects Cushing President at Annual Meet

Lake Morey, Vt.—Although there has been more damage to the Vermont telephone plants during June than during the entire previous year, the Telephone Association of Vermont held its biggest annual meeting here June 18 and 19. The seventy Independent companies of Vermont and the Bell interests of the state were well represented in the lively sessions.

The meetings were held on the conference plan, there being a managers and plant conference, traffic conference, and a joint conference. Features of the conference subjects were:

County Telephone Company.—"Modern Switchboard Problems."

"What Is Necessary to Prepare for Summer Toll Traffic?"

"Co-operation between Regulatory Bodies and Public Utilities."

"Co-operation between the Toll Center and the Tributary."

"Local Operating Efficiency."

"Chargeable and Non-chargeable Reports and the Accurate Timing of Toll Calls."

Discussion.

"Co-operation Between Plant and Traffic."

"Accounting for Small Telephone Companies."

"Practical Helps in Connection with the Construction, Maintenance and Operation of the Business and Co-operation between Electric Light, Power Companies and Telelphone Companies."

"Necessity for Appraisal of Telephone Plants."

"Telephone Rates and Development."

"Stimulating the Toll Business and Suggestions on Ways and Means of Increasing Per Cent. Completed, especially Sunday and Holiday Traffic."

Among the notables at the Vermont convention were J. G. Ihmsen of the Up-State New York association; Hon. Henry B. Shaw, chairman of the Vermont Public Service commission, and officials of the New Hampshire Telephone association, among whom were F. O. Lendbery, president, and J. F. Tierney, secretary.

Officials elected at the Vermont convention:

C. D. Cushing, Seattle, President.

C. L. Spears, West Corinth, Vice President.

C. L. Ovitt, Enosburg Falls, Secretary and Treasurer.

F. Harding Chesmore, Jonesville, Auditor.

The directors are: C. D. Cushing, Bethel; F. Harding Chesmore, Jonesville; A. W. Foote, Middlebury; C. L. Spears, West Corinth; F. W. Story, Boston, Mass.; M. W. Hicks, Granville, N. Y.; C. L. Ovitt, Enosburg Falls.

Battling With Electrolysis

How and Where Electrolysis Plays Havoc with Telephone Plant—Protecting Against Electrolytic Ravages—Testing Methods—Insulated Joint Remedy

By P. KERR HIGGINS

Text books usually tell us of the large amount of decomposition which takes place in the electric depositing bath; but this must not be confounded with the electrolytic action between street car rail and lead cables in the ground, as the actual damages done in the case of the latter is only between ten and fifteen per cent of that which takes place in the electric bath. In the former the best conditions are established, while in the latter possibly the worst. That this is true has been time and again demonstrated by tests made under almost all conditions. Many people are accustomed to associate the term "electrolysis" with the forces of destruction and seem satisfied to stop there. It is true electrolysis is the cause of much destruction to telephone equipment on the outside plant, but its beneficial action in other industries is of so much greater importance that this destruction is a small matter in the larger sense. Its influence upon science and art is of such great magnitude that it can hardly be over-estimated. We owe some of the great discoveries of electrity to electro-chemistry.

The discovery of electrolysis is credited to Daniell who observed a deposit of copper while experimenting with a cell that bears his name. The first description of the process was published in 1839 by Jacobi of St. Petersburg. It was first put into practical use by Elkington. In about 1800 Nicholson and Carlisle discovered that an electric current when passed through water could decompose it into its constituent elements. In 1807 Day developed the theory that all compounds consist of two portions, one electro-positive and the other electro-negative. To Faraday belongs the credit of coining the name of electrolysis; he gave this name to the process of decomposition of compounds in solution by the agency of the galvanic current, the substance so decomposed being called the electrolyte, the conductors immersed in the liquid being termed the electrodes; anode is the electrode corresponding to the positive pole, the cathode is the electrode corresponding to the negative pole. The substances that are produced by the agency of electrolysis are called ions and these are divided into anions and cations, according to their appearance on the anode or cathode poles. Compounds when subjected to electrolysis are not decomposed throughout the mass, but the decomposition occurs at all points between the electrodes. In compounds made up of two elements, one element unmixed with the other is given off of each pole, and always from the same pole. In case of compounds containing more than two elements, a similar decomposition occurs, one element being liberated at one pole and the remainder at the other pole.

Chemical affinity exists by virtue of the electrical attraction exerted between the atoms of oppositely charged elements. The electro-negatives or acid radicals are oxygen, chlorine, SO_4, etc. The electro-positive or basic radicals are hydrogen and the metals. There is a force within all elements which seems to guide their formation. Bodies which seem endowed with the power of attractmg other bodies are said to be electrified, while other bodies oppositely electrified attract each other. Chemical combination is accomplished by the electrical attraction that is exerted between the oppositely charged elements that are brought within their sphere of electrical influence. An electric current has no chemical effect while passing through a solid conductor. However, when the current passes through any liquid conductor other than an elementary substance such as molten metal the liquid is decomposed and chemical action is noted at one or both electrodes.

Gases seem to conduct electricity by convection, the atoms carrying positive and negative charges between electrodes. If the gases are hot, there seems to be an electrolytic action similar to that occurring in liquids and in some cases there is a secondary reaction, so that the atoms originally liberated by the current form into other combinations before they can be liberated at the electrodes. Electrolysis is a slow process and much damage may be done where it occurs in the telephone plant before we are aware of its presence.

Substances may be divided into two groups, namely simple and compound substances. The simple substances, about seventy-eight in all, are those having one kind of material. Compound substances are combinations of simple substances. As an example of a simple substance, iron may be taken, as it may be powdered, melted or vaporized and yet retain its nature as a chemical element. If iron is exposed to the atmosphere, it begins to combine with oxygen and if allowed to continue long enough exposed to the air, the iron disappears and there remains a quantity of iron oxide or rust, the weight of which will be equal to the weight of the iron plus the oxygen absorbed. Water is one of the most common compound substances. If we dip two platinum wires connected to the poles of a battery into a vessel containing water, gas bubbles will arise around each of the wires. The gases liberated by the electric current are hydrogen and oxygen; hence we conclude these gases are the simple constituents of water.

In electroplating, the electric current is used for the decomposition of the solutions used. Hence, if we desire to silverplate an article we connect it with the negative pole of the battery and connect the positive pole with a piece of silver. By immersing these in a solution of silver, the silver compound in solution is decomposed and silver is deposited on the article. The acid radical of the solution attacks the piece of silver connected with the positive pole of the battery and gradually dissolves it. Again, when an electric current passes through a solution, decomposition of the solution takes place and the conductor by which the current enters the solution will be attacked if such conductor is one which can be oxidised. An electric current flowing from a piece of metal to a liquid or moist body touching it, will dissolve some of the metal, carry it away and deposit it where the current enters against a solid. The two fundamental laws applying to electrolysis are first the well known Ohms law, and the not so well known Faraday law, as follows: $M = f \times c \times t$; M is the amount of metal carried away; c is the current measured in amperes and t is the time; f is a number depending upon the kind of metal used. The formula means that the dissolved amount is proportional to the current and to the time, one ampere flowing for one hour dissolves approximately .035 oz. of cast iron, two amperes flowing for one hour dissolves .070 and so on. Other metals are acted upon more violently, the ratio being approximately as

follows: Cast iron to wrought iron to lead as one to three to seven.

Electrolysis of Lead Important in Telephony

While we are interested in iron, lead stands out pre-eminently in our study of electrolysis as applied to telephony. The moisture held in the ground in which the cable sheath is imbedded is also important. Pure water has a very high resistence, with small electric pressure. Acidulated or salt water having less resistance and the heavy currents may flow even with small electric pressure. Reversed pressure is known as counter-electro motive force and tends to act against the generation of current. Many people are of the opinion that so long as the voltage between the cable sheath and the surrounding ground is less than two volts, no current can flow. This is an error. It is also a mistake to believe that counter-electro motive force will protect cable.

In the study of dangerous current for cables, the following must be carefully considered: First, the origin, second, the intensity, and third, the direction and action of the current. The earth at the present time is used as the common return for much of the energy that is sent out from the great man-created dynamos. Every electrical current must find its way back to its starting point either by the employment of a metallic circuit or by sending out the current from a starting point on a metalic conductor and grounding the other end at its destination, using the earth for the return. Most electric railway companies use a modification of this plan. The iron rails are supposed to be one side of the metallic circuit, but in practice much of the current leaves the rails and seeks a path of less resistance through the earth and along buried metal conductors, apparently with a preference for telephone cables, water and gas mains.

In Telephony the term electrolysis is used almost exclusively to describe or define the action produced by this stray current. The word is apparently derived from an abbreviation of two words "electro" and "analysis" and evidently indicates the analysis or decomposition taking place due to the above described action. It is to be regretted that lead exclusively used for cable sheath is so susceptible to electrolysis, but this apparently cannot be helped and our efforts therefore must be toward preventing the action above described. It is said that decomposition of iron pipes by electrolytic action almost entirely ceases after the current has been flowing in the same direction for some time, while in the case of lead it is practically continuous while the current is flowing. The use of vitrified tile or other suitable protection for conduits reduces the damage to a minimum, while exposed cables or those in iron ducts seem to receive the maximum amount of damage due to electrolysis.

To understand the action of electrolysis of lead, some knowledge of the characteristics of lead may be useful. Lead is one of the softest of metals. It can be scratched with a nail, easily cut with a knife and makes a streak on paper. The specific gravity is 11.33 or for its volume over eleven times as heavy as water. The color is bluish white, tending to gray, with bright metallic lustre when newly cut. The bright surface is soon tarnished when exposed to air, by taking on a film supposed to be a sub-oxide. The melting point of lead is about 633° F. It is highly malleable, easily rolled into thin sheets or when slightly heated forced through perforations as in the making of lead pipe. It is slightly ductile and has so little tenacity that wire 1/12 in. in diameter will not support a load of twenty pounds. It is not elastic and so when stretched or bent will not regain its shape. If you bend a lead pipe through an angle of 90° the thickness of the pipe on the outerside of the turn is materially reduced and though you bend it straight again the pipe remains thin and weak at that point. Lead will last indefinitely under favorable conditions. Nitric acid will dissolve lead readily. Acetic and hydro-chloric acids act slowly. Sulphuric acid seems to have no action unless hot. Pure rain water in combination with the free oxygen in the air forms on the surface of lead a hydrated oxide (Pb O H-2 O). This dissolved in the presence of carbonic acid, leaving room for further corrosion. This action is further intensified by the presence of nitrates or ammonia in the air. Lead in telephone service is subject to the following injury or damage. First, mechanical injury. Second, chemical decomposition. Third, vibration. Fourth, impurities in the lead. Fifth lightning. Sixth, electrolysis. Seventh, boring insects.

Electrolysis Occurs Where Current Leaves Cable Sheath

It is found that electrolysis occurs at points where stray currents leave the cable sheath and enter the ground. At this point oxygen and other chemicals in the ground are liberated which rapidly corrode the lead sheath. When rails are properly bonded or when return feeders are used, the leakage, or stray currents are reduced to a minimum, but they cannot be completely eliminated. Where the current enters the cable sheath, no damage seems to be done, but only where it leaves the sheath at a moist spot. This condition may be avoided by connecting the lead sheath to the trolley rails at frequent intervals with leads of heavy copper wire or by running a feeder from the cable direct to the negative bus-bar of the power house. Where this is not practical, the stray currents may be carried off to a well grounded copper plate. Absolutely pure water seems to have no action by itself, but in the presence of the free oxygen in the air, lead is quickly attacked with a formation of hydrated oxide, which forms an alkaline liquid.

In ducts which are not properly drained the presence of carbonic acid gas is frequently noticeable. The water seems to percolate from the surface of the street and in traveling through the ground picks up sulphur and nitrogen compounds with which the ground is permeated. In many cases it also gathers chlorine. When passing into the duct through the ordinarily poor cement joint, it gathers up carbonate. The water also in its travels seems to gather up tannin from the dead vegetation, so that by the time it reaches the lead cable it is ready for business. It will be noted that, having passed through this process, there is now in the subway all the component parts necessary to begin making white lead out of the cable sheath. The action is intensified by a slight element of heat from the stray current escaping from the street rails. May it therefore not be said that electrolysis is simply another form or process of making of white lead?

It makes no difference what is done with the lead sheath, for if it is thick it will simply take longer to eat away than if thin, but it will decompose just the same unless preventative measures are taken. It is therefore important that in building conduits the following be remembered. First, so build the conduit that no water can lie in any part of it. In other words drain both ways from the middle. Second, make all joints as nearly water tight as possible. Third, make regular electrical surveys and ground the cable in accordance with the results obtained. It is well also in this connection to remember that sulphur dioxide, which is present in most cities and especially bad at railroad crossings and in railroad yards and under railroad bridges, is very destructive to the lead sheath of aerial cable. Certain factories also produce gases which are highly injurious. In these latter cases it is recommended that cables be given a thick coating of Ever-Protect Compound or asphalt paint.

Action Depends on Rate of Current Flow

The extent of the electrolytic action taking place usually depends upon the strength of the current and the nature and amount of metallic salts contained in the earth to which the current escapes. The rate of injury by electrolysis is proportional to the quantity of the current multiplied by the time, so that one ampere action for two hours produces the same result as two amperes action for one hour. In localities where there are elec-

tric railways and underground conductors, places can generally be found where electrolytic action is liable to occur. The electric current may be regarded as leaving the power house over the trolley wire through the car motors to the rails or special conductors, including the earth, water pipes, lead sheathing of cables, etc., as shown in Fig. 1. The theoretical circuit is shown in Fig 2. Each available

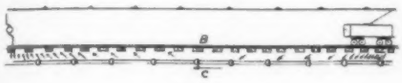


Fig. 1.

path will carry its proportional current, the amount depending on the nature of the path and the difference of potential between its terminals.

Danger Areas Are Located by Voltmeter Tests

By means of suitable tests it is possible to ascertain the localities where the current has a tendency to flow to the cables, and at these places the cables are said to be negative to their surroundings and the conditions are as a rule favorable for the preservation of the lead sheath. In other locations the current will have a tendency to leave the cables through the moisture or damp surroundings and if permitted to do so, electrolytic action will be the result. If the surrounding earth owes its conducting qualities to the presence of ordinary water only, the action may be explained by saying that the current decomposes the water and liberates the oxygen at the surface of the lead sheath. The oxygen when freshly liberated is in its most active state and readily attacks the lead forming lead oxide. This is electrolytic action in its simplest form. The presence of salts dissolved in the water and the presence of carbonic acid gas will give rise to other compounds and complications. The whitish compound noticed where the lead has been attacked is generally a carbonate of lead. The purpose therefore is to prevent electrolytic action by rendering the cables negative or at least to prevent the current from leaving the cables to the earth. This method is known as bonding.

It is important to have periodical volt meter readings taken on all underground installations at each manhole in order to ascertain the direction and quantity of current flowing between the rails and cables. However, we must not accept blindly the result of the voltmeter test, which might show that the direction of the current from the rails to the cable is positive, that is the current leaving the rails and entering the cable, which would indicate a safe condition, but we must also see if there is any leakage of current from the cables to the earth which would indicate a dangerous condition.

Method of Bonding

The following method of bonding is used by a large company. A heavy stranded copper cable was extended from the manhole where the highest positive potential to rail occurred to the nearest street railway return. This cable was connected or strapped to all the cables in the manhole by means of copper strips soldered to each cable in the manner shown in Fig. 3. As the cable system was extended, it was found necessary to string street railway return cables for a considerable distance from the power house to take care of the current picked up by the telephone cable. The street railway company was glad to string these returns and thus reduce the energy loss. Later it was found to be necessary on account of distance to connect the

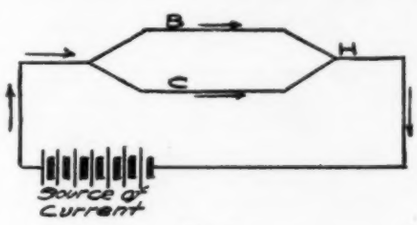
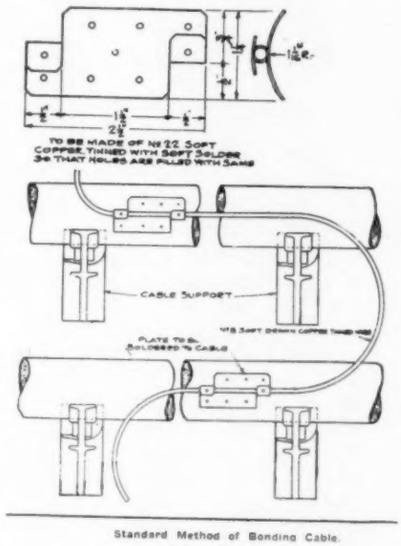


Fig. 2.

cables directly to the rails by means of heavy copper wire, No. 0000, soldered to the stranded copper cable which under present construction method are laid between the rails and connected alternately to each length of rail.

The old method of rail bonding depended upon small copper wire joints at the ends where the rails joined one another. In cases of this kind where it is found necessary to make a bond, the street railway people drill a hole in the rail near the manhole and under pressure force a solid copper stud into the rail. The wire from the manhole is then soldered to this copper stud after carefully



Standard Method of Bonding Cable.

Fig. 3.

soldering the cables to the bond wire in the manholes. This insures a good electrical contact. It is also well to connect all of the cables in manholes at different places throughout the system together for the purpose of reducing the resistance as much as possible. This should be done at intervals of not more than an eighth of a mile, and in most places less, particularly at junction manholes.

Tests and Testing Methods

The following is one of the methods used in testing for electrolysis. Two wooded rods, one red (to end post of voltmeter) and one black about seven feet long, are provided, each having a blunt, brass point and connected by a flexible insulated conductor with a portable voltmeter, having a graduated scale from .01 to 25 volts. Tests should be made at the manholes as these are the most convenient points for reaching the cable. One of the brass contact points should be placed in firm contact with the lead cable sheath and the other in contact with the moist earth, by means of thrusting the rod through the drain tile in the bottom of the manhole and the voltage noted not only in amount but in direction. Readings must also be taken between the cable sheath and the rails of the adjacent electric railway, or other return feeders that may be in the immediate vicinity. As previously stated where the cable sheaths are negative to their surroundings no danger may be expected, as this would show the current flowing from the earth to the sheath. If, however, the cable is found positive to the surrounding earth or traction rails the fact should be carefully followed up by taking readings in successive manholes until the danger region has been entirely covered. In this way the maximum danger point can be found, being as a general rule the point at which the maximum difference of potential exists.

It is at this point the cable sheath should be securely bonded by a heavy conductor to the return feeders or direct to the negative busbars of the dynamos at the power house. Such a bond will permit the current to flow from the cable sheath through the bond instead of forcing it to flow from the sheath to the earth. The bonding strip should be of copper not thinner than .028 in. or narrower than 1.0 in. and should be wiped on to each cable so that the electrical resistance may be as nearly zero as practical. In making these tests see that all the cables in each manhole are of the same potential. In making such tests it is well to be sure that a complete cycle of changes on the street railway has occurred during the time the readings are being taken; otherwise the readings will not show the actual condition to which the cable sheath is subjected and these

must be definitely known before the protection bond can be properly located.

Map Is an Aid in Testing

In making the tests it is also well to remember the following steps. First, make a map showing the location of the street railway power house and street railway rails, and return feeders. A map of the underground conduit system is very convenient for this purpose as it also shows the layout of the underground conduit. Second, ascertain the voltage at which the outgoing feeders are fed, also the carrying capacity of the incoming feeders and the maximum and minimum current output. It is very important to note that the trolley has a positive polarity. If negative it is practically impossible to get rid of electrolysis trouble. Under no condition should the cable sheaths at any point be positive to ground or traction rails.

There are two main methods of preventing leakage of traction current. One is by the double trolley system and the other is a complete insulation of the cable sheath. Recently a prominent engineer has suggested the use of insulated cable joints which seems to have advantages although the writer has had no experience with this method. It is almost if not impossible to completely insulate an underground cable system.

The use of the track as a return conductor by the railway companies is simply an economic measure. They must have a track and as a perfectly bonded forty pound rail has about the same resistance per mile as two copper wires one inch in diameter, it is apparent that there is considerable saving in using the rail instead of stringing extra feeders. As the best copper rail bonds frequently break, experiments have recently been carried on with considerable success in the use of cast welded joints. The theoretical resistance of a perfectly bonded track may be calculated if the weight of the rails is known by means of a mile-ohm law, which is the weight of a uniform conductor one mile in length and having a resistance of one ohm, which in the case of steel is about 6,500 pounds. By dividing this constant (6,500) by the weight of both rails, we obtain the theoretical track resistance, which if divided by two will give the resistance of a double track. The weight of rails is usually given in pounds per yard and the following table gives a very good idea of track data as it might exist under a welded or heavily bonded joint. The sixth column in this table indicates the number of amperes giving a drop of one volt per mile. Each car will take about double the amount of current given in this column. Thus there will therefore be a loss of at least two volts per mile for each car running at the extreme end of the track.

Weight of Rail per Mile	Track Weight per Mile Single	Track Weight per Mile Double	Res=6500 weight per mi. Single Track	Res=6500 weight per mi. Double Track	Amperes per 1 volt loss Single Track
40	140,800	281,600	.04616	.02308	22
60	211,200	422,400	.03078	.01539	32
66	232,320	464,640	.02800	.01400	36
80	281,600	563,200	.02344	.01172	43
90	316,800	633,600	.02052	.01026	48
100	252,000	704,000	.01847	.00963	54

The conditions in the cable system before and after bonding are shown graphically in Fig. 4 and Fig. 5. Fig. 4 shows the condition before bonding has been performed and Fig. 5 shows the condition after remedy is applied.

Voltage and Current Tests

A method of testing for electrolysis which gives some additional information involves the use of both voltmeter and ammeter, readings being taken separately and together. This is shown in Fig. 6. The formula is as follows:

V=voltage with ammeter cut out.
V_2=voltage with ammeter cut in.
A=ammeter reading } $V_1 - V_2 : V_1 :: A : X$
X=required amount }

Formula

In one case the average EMF found was about 8 volts and the current from 80 to 100 amperes. These tests were made when the station load was between 1500 and 2100 amperes.

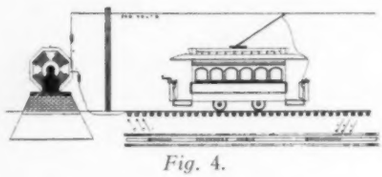


Fig. 4.

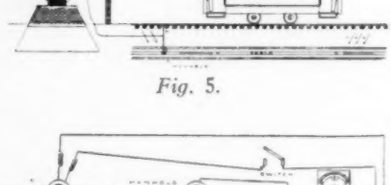


Fig. 5.

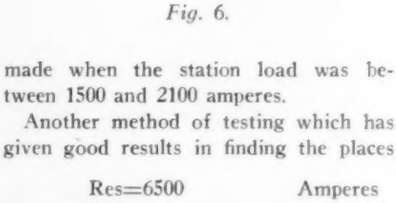


Fig. 6.

Another method of testing which has given good results in finding the places where the leakage is greatest is by having a test car (provided with water resistance) go over the route, after all the cars have stopped running, arranging stops to be made at certain intervals of time and have the current shut off at these stated periods and having recording ammeters connected up at the station as shown in Fig. 7. R to the rail and C to the cable, a record can be had and a list drawn up from it showing that the amperage increased or decreased between certain points at a certain time indicating less or more resistance to ground at these points. In this way the weak points along the route may be readily located. We then go over the route which the test car passed over and compare the low resistance points on the chart with the route of our cables and see whether the low resistance is due to close proximity or actual contact of our cables or is due to foreign contact such as water or gas mains. It is well in this connection to watch carefully all contacts in manholes between foreign pipes or conductors and cables. Also iron braces, fenders or manhole covers as these frequently cause trouble, more especially when they are in contact with the street car rails. It will be observed in many cases when tests are made that a peculiar accumulator effect presents itself if (for any reason) the power should be suddenly shut off, the ammeter showing a current flowing in the opposite direction to that flowing when current is on. In the case of lead cables, this is very marked and registers often as high as ten to fifteen amperes, gradually dissipating itself. This should be watched carefully as it may cause confusion in making tests.

In dealing with the traction people it is well to approach them in a tactful manner and not to antagonize them in any way. If this is done, you will usually find them willing to assist you in making tests and connections. If, however, they are obdurate and absolutely refuse any concession in the way of tests and contacts at power stations and rails, then the only alternative is to complain to the public service commission or the city council as the case may be and explain to them the damage being done and ask an order to the traction company to grant the privileges desired.

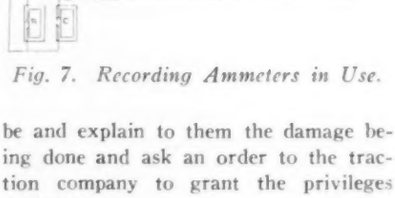


Fig. 7. Recording Ammeters in Use.

(Continued on page 39.)

Automatic Trunk Grouping

Trunking Between Different Classes of Switches—Trunking in 10,000 Line Systems—Traffic Data for Determining Trunk Groups—More Switch Efficiency

By F. J. DOMMERQUE

(*Fellow A. I. E. E.*)

Every telephone man is familiar with trunking in manual practice. The trunking problem is to be solved for all multi-office telephone plants, but the manual trunk grouping is a very simple affair. The number of outgoing trunks required from each office to each one of the other offices is ascertained by formulae or from trunk curves such as were presented in the April, 1925, issue of the TELEPHONE ENGINEER. In manual operation direct trunklines extend from each office to each one of the other offices and therefore no bunching of groups can be effected, the outgoing trunklines are connected at the A-board to outgoing trunkjacks which are multipled throughout the A-board, and terminate at the B-board in plugs; that ends it.

In automatic operation trunking becomes a more complicated affair, as every connection including local connections requires at least one trunkline, usually more than one, and frequently proceeds through a number of offices in tandem, where bunching of trunkgroups is practiced to great advantage. The line switches, group switches and connectors are joined by trunklines, regardless whether they are located in one and the same office building or are distributed over the plant in a number of offices. The distribution of the switching apparatus over a number of offices in no way changes the circuits and operation of the system nor the assemblage of apparatus, the subdivision into offices simply means a lengthening of the trunklines between the various classes of switches.

It is essential to keep in mind the difference between the connections of the switches in a class and the connections between classes. The connections of the switches in a class are arranged on the principle of multiple wiring, well known from manual practice. It is assumed that all lines entering an automatic exchange go first to line switches, which are in the Strowger systems nearly always of the rotary motion kind, with 10 contacts in a semi-circular level over which the brush or wiper rotates. If the scheme of forward or direct selection is adopted, that is, if the subscriber's lines are connected to, or terminate in the line switch wipers, no multiplying of subscriber's lines in the lines switches is necessary, but the trunklines going out from the line switches must be multiplied.

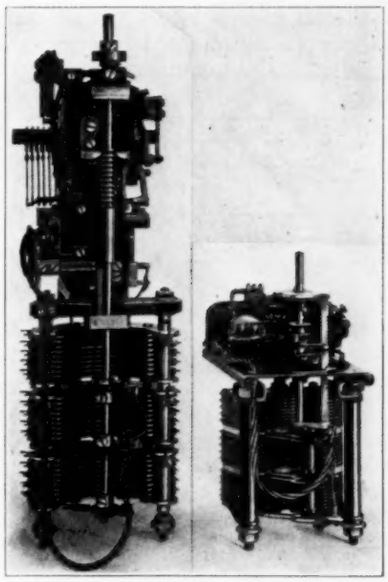


Fig. 1. Two-motion Switches, Strowger Type.

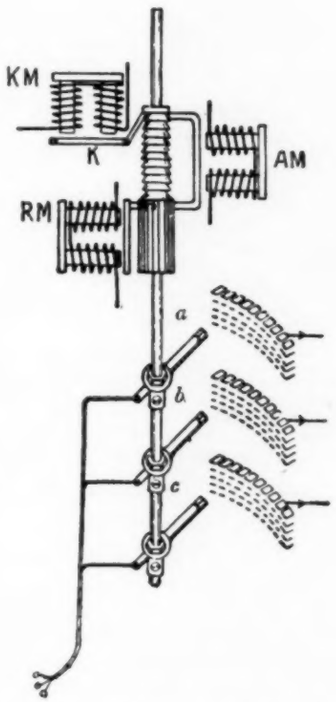


Fig. 2. Essential Elements of a Two-Motion Switch.

In the Keith line switch the outgoing trunklines are also multiplied, but in addition each subscriber's line is multiplied in the level of 10 contacts so as to furnish a possibility of connecting the subscriber to any trunkline which may be found idle at the origination of the call.

In the method of back selecting, that is, where the trunkline is connected to the wiper and the subscriber's line to the fixed contacts, at the instant when the subscriber lifts his receiver from the hook, the wiper to which the trunk is connected, is set in motion and searches for the calling line.

The groupswitches and connectors are of the two-motion (vertical and rotary) kind. An illustration of a two-motion switch is given in Fig. 1. There are two switches shown, to the left the familiar Strowger type, and to the right its latest "Made in Germany" edition. The two are photographed side by side to the same scale so as to indicate the reduction in size from the old to the new design. The new one is only half the size and costs much less than the old one. For the discussion of trunk grouping the old type will be taken as better known; however, the new type does not vary in circuit wiring nor operation from the old one, the only difference being in its design.

In Fig. 2 are sketched the essential elements of a two-motion switch. There are three wipers, a, b and c; two, a and b, are used for the two sides of the line and the third one, c, for the private wire, which serves for testing and other functions. Each wiper wipes over its bank of 100 contacts, 10 levels of 10. Only a few levels are shown in the figure, but there are 10 levels in each of the three banks. Sometimes the two line banks are combined into one. The wipers are stepped up by means of the vertical magnet VM and its armature K. They are rotated by the rotary magnet RM and returned to normal position by the release of magnet AM.

The number of outgoing trunks in a

group required to accommodate the traffic will be determined presently, suffice it to remember just now that in the Keith and other rotary line switches ten has become the regular number for 100 subscriber's lines. Consequently, omitting secondary line switches, the ten trunks outgoing from the line switch unit of 100 lines, will be incoming in ten groupswitches or in ten connectors in a 100-line exchange; they terminate upon the wipers, each trunkline comprising three wires, two for the line and the third one the private wire. The bank contacts in the first groupswitches of three-, four-, or more figure exchanges are multipled in 100 groupswitches by joining in the 100 switches all the contacts having the same number as will be explained in detail. As the second, third, etc., groupswitches are all the same in operation and design, the banks of 100 second selectors have their corresponding contacts multiplied. In the connectors the subscriber's lines are connected to the line banks, each connector line bank accommodating 100 lines. The banks of 10 connectors are multiplied, so that the same 100 lines are accessible over 10 connectors.

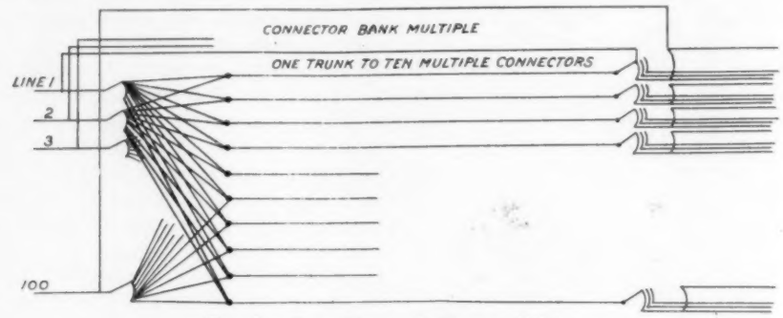


Fig. 3. Two-Figure Exchange Wiring.

Trunking Between Different Classes of Switches

After this general statement of the multiplying of the switches in each class, the connections between the classes will be examined, which will still further elucidate the arrangement of wiring in the classes themselves.

Taking the 100-line or two-figure exchange first, it may be assumed that every subscriber's line terminates in the wiper of an individual rotary line switch, which is the preferable method for small exchanges. This line switch may have as few as ten (the usual number) or as many as twenty-five trunks going out to the connectors. The diagram in Fig. 3 is a skeleton representation of the wiring for a 100-line exchange.

The 100 lines, before they come to the 100 individual rotary line switches, are multiplied to the connector bank. The line switches are assumed to have ten sets of bank contacts only. Each line terminates in a wiper; the banks have their contacts connected to the outgoing trunklines so that every subscriber can reach any one of the ten outgoing trunks. The diagram does not require any further explanation; each segment or arc ( ) represents a level containing ten sets of contacts, each set comprising the two-line contacts and the private contact; one wiper in the diagram stands for the three wipers corresponding to one set of contacts.

In Fig. 4 the wiring arrangement is extended to a 1000-line or three-figure exchange. The line switches may be individual rotary or Keith line switches, perhaps the latter may be cheaper. If rotary line switches with ten contact sets are chosen, each line switch unit of a 100 lines will be a repetition of the line switch arrangement shown in Fig. 3; thus there will be for a 1000 lines ten repetitions of the line switch arrangement. If Keith line switches are used, the subscriber's lines will go to sets of springs in the lineswitch bank and the trunks will leave from the associated springs in the sets. The wiring of the trunklines and the subscriber's line multiple to connectors will not change.

The connectors for a thousand lines are arranged in the same way as for hundred lines, that is, there are ten repetitions of the 100-line scheme, one repetition for each hundred. In diagram Fig. 4 only one connector is shown for every hundred lines instead of the ten in multiple as in Fig. 3, in order not to make the diagram too complicated. The method of trunking undergoes a change insofar as groupswitches are inserted between line switches and connectors. From each 100-line unit ten trunklines go out to the groupswitches. Therefore, for the thousand lines there will be ten "groups" of ten trunks each. In diagram Fig. 4 for each hundred lines one trunkline only is drawn with its groupswitches, this single trunk and the single groupswitch stand for a "group" of ten trunks and ten groupswitches respectively. As the diagram further shows, these trunklines terminate in groupswitches upon their wipers, while other trunks leave from the groupswitch banks for the connectors. How the groups of groupswitch banks are multiplied is shown in the diagram, and also how the outgoing trunklines are connected to the groupswitch bank multiple. These trunks also form groups of ten and terminate in the wipers of the connectors, the latter being multiplied. A trunkgroup of ten trunks and a connectorgroup of ten connectors is represented in the diagram by a single line and a single connector respectively. The groupswitch group multiple gives each one of the thousand subscribers access to any trunk going to the connectors. The diagram needs no further explanation. It will be understood that each segment or arc ( ) in the diagram represents a

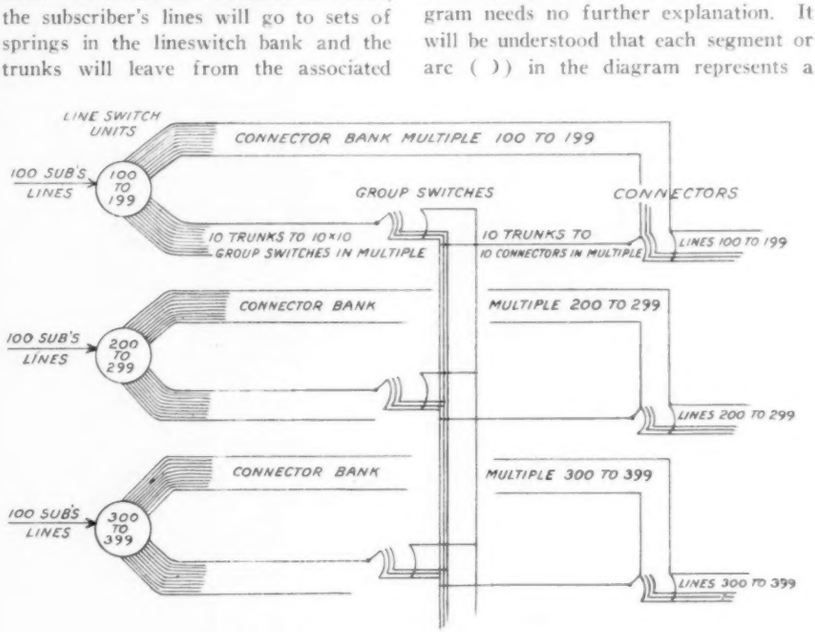


Fig. 4. Three-Figure Exchange Wiring.

When the calling subscriber dials the first one of the three digits in the called subscriber's number the groupswitch wiper is lifted to the level indicated by this digit and immediately starts to ro-

tate hunting for an idle trunk. In the connector the dialing of the second digit lifts the wiper to the level indicated by this second digit and the wiper starts to rotate only after the subscriber has dialed the unit digit. If the contact is found idle the connection to the desired line is complete.

Trunking in 10,000 Line Systems

For 10,000 lines, that is, for four-figure exchanges, there are first and second groupswitches required, the first groupswitches serving to select trunks leading to groups of second groupswitches which contain trunks leading to the thousand-groups of subscribers. The first digit in the desired number is the thousand-group. The second groupswitches connect to the groups of connectors which contain the hundred-groups of subscribers indicated by the second digit in the desired number.

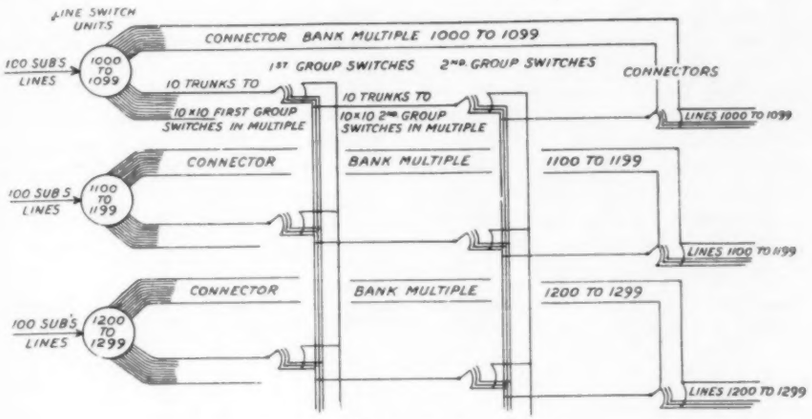


Fig. 5. Four-Figure Exchange Wiring.

There are required ten connectors for each hundred lines, hence hundred for each group of thousand lines. There are ten levels in every second groupswitch and from each level go out ten trunks to ten connectors, the first or lowest level containing the trunks to the ten groups of connectors in the thousand-group, from the second level the trunks to the ten groups of connectors in the 2,000-group and so on. There are, therefore, altogether ten times one hundred or a thousand second groupswitches and one hundred trunkgroups of ten trunks each.

From every level of a first groupswitch go out the trunks to ten second groupswitches, so that through the ten levels of the first groupswitch access is to be had to ten second groupswitches in each of the ten sections of thousand lines. Consequently there are required one hundred times ten or one thousand first selectors. Otherwise the 10,000-line exchange is a repetition of the 1,000-line exchange, or rather an extension on the same lines. The diagram Fig. 5 plainly shows how the wiring diagram of the three-figure exchange is extended to a four-figure exchange by the addition of second groupswitches. As this diagram covers only a few hundred of the 10,000 lines, which may be sufficient to divulge the arrangement of the switch classes, a second diagram Fig. 6 is added which illustrates the grouping for every thousand lines and the interconnection of the switchclasses on a more extensive plan. Each line in the diagram represents a trunkgroup.

It must be understood that the diagrams Figs. 3 to 6 are theoretical. In practice the levels in the switches can not all be devoted exclusively to subscriber's lines, provision must also be made for the accommodation of special service lines, such as are used by inspectors and troublemen for testing purposes, also of lines for complaints and information, and, which is of still more importance, of lines or trunks to or from manual offices, which may be operated in conjunction with the automatic office during the time of transformation of the system. How many levels should be reserved for such special purposes depends on local requirement, which can not be fixed generally, but the experience from manual operation will serve as a guide.

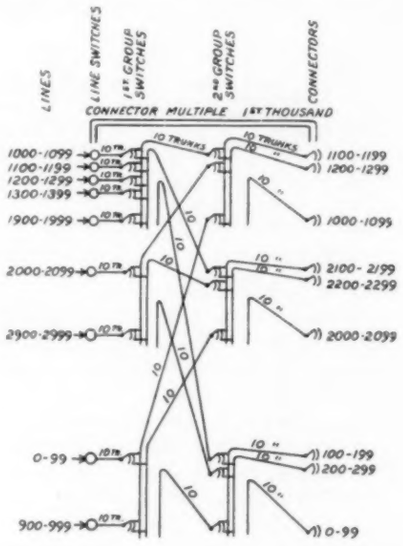


Fig. 6. Trunk Groups of a Four-Figure Exchange.

After what has been said it should not be necessary to explain the 100,000-line exchange wiring, as the addition of a third groupswitch means only a repetition of the arrangement of the second groupswitches in a four-figure exchange, while the arrangement of the second groupswitches corresponds to the one of the first groupswitches in a four-figure exchange. The first groupswitches in a five-figure exchange select the trunklines leading to the 10,000-groups of subscribers, which are indicated by the first digit of the five-figure number.

Traffic Data for Determining Trunk Groups

It will now be clear that all trunkgroups in the discussion so far contain ten lines. Manual practice has demonstrated that the average of simultaneous existing connections from 100 calling lines rarely exceeds ten. With progressing development of automatic operation the traffic requirements become an essential subject of study. Observations were made from time to time and at the present stage well-founded and reliable data are at hand.

It is not only the number of simultaneous calls which is of importance for the determination of trunks in a group, but also the duration or length of connection. Duration of connection and duration of conversation are not one and the same. The duration of connection includes the time used for setting up the connection, the waiting time on the part of the calling subscriber for the called subscriber to answer, the actual conversation time and the disconnect; it also includes any time lost on account of trouble in the switches. It, therefore, is correct only to speak of simultaneously existing connections as one of the determining factors for the trunkgroups.

The duration of connection varies considerably with the kind of conversation, residence calls as a rule are of much longer duration than business calls; furthermore, calls of all kinds are slower in small places and increase in speed with increasing density and magnitude of population. It may be safe to fix the limits for the average duration of connection as two and three minutes respectively.

For a 10,000 line or four-figure exchange a maximum number of 450 simultaneous existing connections has been determined by observation. This figure of 450, however, is based upon the assumption that all the calls pass through as one group of 10,000, and therefore it is only a theoretical figure. Practically

a 500-group is the highest number of callgroup. Decreasing the number of calls in a group, that is, subdividing a large group into a number of smaller groups increases the number of trunks required per group, and thereby the total number of trunks, because in one large group a call has a greater choice of trunks to get through, than if the same call were restricted to a small group.

If for a group of 10,000 the highest number of simultaneously existing connections is 450, which also means that for a 10,000 group 450 trunks will carry the traffic, the number of trunks to carry the traffic through twenty 500-groups is not 22.5 per group, but 30, or a total of 600. For groups of 200 the number required per group would not be 9, but 16; and for groups of 100 it would not be 4.5 but 10.

These figures are for a "Probability of one in a thousand," which means that out of a thousand calls probably one will not find an idle trunk or switch, and thus will be lost. The probability of a call getting lost determines the efficiency of the installation or at least is a prominent factor in the determination. One in a thousand is a high efficiency and all that can be desired for good service.

It is evident, that for the same total of trunklines the efficiency increases in proportion to the increase in trunklines in the groups. Thus the efficiency of 100-line switches with trunkgroups of 10 is lower than the efficiency of 200-line switches with trunkgroups of 20, and the efficiency of 200-line switches with trunkgroups of 20 lower than the efficiency of 500-line switches with trunkgroups of 50. This, however, does not necessarily mean that the economy increases in the same proportion. With larger trunkgroups fewer switches are required, but the fewer cost more money to build. Systems with 200-line switches and 500-line switches are still too new to have arrived at their most economical stage, therefore there are no final and sufficient data available as yet for comparison.

Increasing Switch Efficiency

To increase the efficiency of switches in general many means have been developed. In the first instance, secondary lineswitches have been introduced, which make it possible to increase the groups of 10 to groups of 20, assuming now again switches of the stronger type and rotary primary lineswitches. Secondary lineswitches are of the same type and character as the primary lineswitches. Taking again a 10,000 line system as an example, as it is not customary to use secondary lineswitches in smaller systems, it is convenient to divide the 10,000 subscribers' lines into five groups of 2,000 lines each, in place of groups of 1,000 lines each without secondary lineswitches. Then the connections are made according to the skeleton diagram Fig. 7.

Between primary and secondary lineswitches a distributing frame is introduced, upon one side of which the trunklines arrive and are cross connected to the terminals for the wipers of the secondary lineswitches on the other side. In the figures distributing frame and secondary lineswitches are shown combined and subdivided in five sections corresponding to the five groups of subscribers.

It may be mentioned that in exchanges employing Keith lineswitches the hundred line primary switches in a unit are arranged in four groups of 25 each. Two of these groups can be connected into one group of fifty so as to make twenty trunks available for the hundred subscribers. Following up this arrangement the trunkgroup of 20 can be made to terminate at the other end in twenty secondary Keith lineswitches and then extend from the latter in trunkgroups of 10 to 10 first groupswitches. Then the secondary lineswitch units are differently arranged from the primary lineswitch units. A unit of secondary Keith lineswitches is divided into eight sections, each one having its own masterswitch; each of the eight sections contains twenty switches.

In exchanges with 10-contact rotary lineswitches the trunks coming in from the primary lineswitches are crossconnected so that only one out of each group of ten terminates in any given secondary section. The first trunk going out from the primary lineswitch unit of the 1,000-1,099 subscribers' group is connected to the first secondary lineswitch in section 1; the second trunk of the 1,000 to 1,099 group to the first secondary lineswitch in section 2 and so on; the tenth trunk from the group 1,000-1,099 to the first secondary lineswitch in section 10. In the same manner the trunks going out from the 1,100-1,199 subscribers' group are distributed over the secondary lineswitches in each section and so on until all the trunks are taken up.

In correspondence with this arrangement each group of 2,000 subscribers' lines contains 20 groups of 100 primary lineswitches each, 200 outgoing trunks, coming in in 10 groups of 20 secondary lineswitches and going out in 10 groups of 10 trunks each to 100 first groupswitches. Consequently for 1,000 subscribers only 50 first groupswitches are required when secondary lineswitches are used, instead of 100 without secondary lineswitches. As in any case 100 lineswitches are considerably cheaper to build than 50 groupswitches, the economy of secondary lineswitches is apparent.

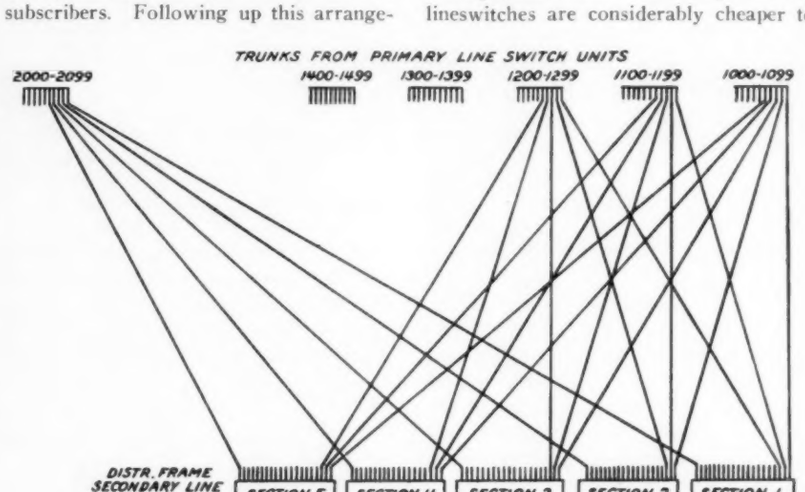


Fig. 7. Connections Between Primary and Secondary Line Switches in 2000-Line Divisions.

There are other and numerous ways of using secondary lineswitches to advantage. For instance they may be used to reduce trunks between offices, they are then placed on outgoing trunks between first group switches and repeaters, of which more will be said later.

Slipping the Multiple

The next important innovation identified with trunkgrouping is "Slipping the Multiple." It is apparent that in any switch in which the wipers return to normal position after every conversation and then begin over again to hunt for an idle trunk with every call, not all contacts will receive the same usage. Observations have been made and it has been demonstrated that in groupswitches

during normal busy hours the first trunk out of ten will carry a maximum of 32 per cent of the total traffic, the second trunk a maximum of 24 per cent, the third trunk a maximum of 18 per cent, the fourth trunk of 12 per cent, the fifth of 7 per cent, the sixth of 3 per cent, the seventh of 2 per cent and the three remaining trunks together a maximum of 2 per cent.

This means that the earlier contacts in the multiple are subject to the heaviest wear and the last ones to hardly any. It also means that the time required for the wipers to find idle trunks is prolonged whenever the earlier trunks are busy and thus the total time of completing connections is increased. A fair distribution of traffic upon the contacts and an abbreviation of the time lost in reaching the farther contacts can be realized by slipping the multiple.

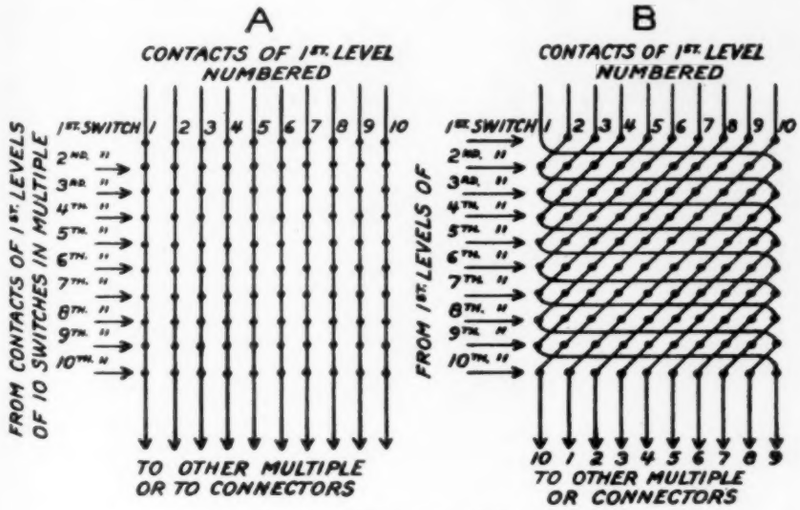


Fig. 8. Slipping the Multiple.

Slipping the multiple consists in arranging the bank multiple so that each trunk appears on a different contact in every one of the banks forming the multiple. How the slipping is carried out upon the connecting rack is shown diagramatically in Fig. 8. The connecting rack shown contains ten rows of 10 terminals each, the terminals having soldering lugs at both ends, so that the wires coming from the switch contacts can be attached on one side of the rack and the crossconnecting can be done on the other side. To avoid unnecessary complications each terminal in the diagram represents the terminals of one complete trunk, that is: position, negative and private wire. To the terminal lugs in the rear may be brought the leads from the switch contacts in the regular manner of cable wiring.

The rack shown in Fig. 8A represents the multiple of the trunks from the first levels of the ten switches in a multiple. Similar racks are to be added for each level; they are, however, not shown here, as they are merely repetitions. As will be seen all the corresponding contacts in the first levels of all the ten switches are connected together, and the same holds true for all the other levels. In Fig. 8B the contacts are connected differently. It will be noticed that the order of trunks first tested corresponds to the order of switches, that is, in switch 2 the second trunk is tested first, in switch 3 the third trunk, and so on.

Slipping the multiple equalizes the wear on the contacts, distributes the traffic more uniformly over the trunks

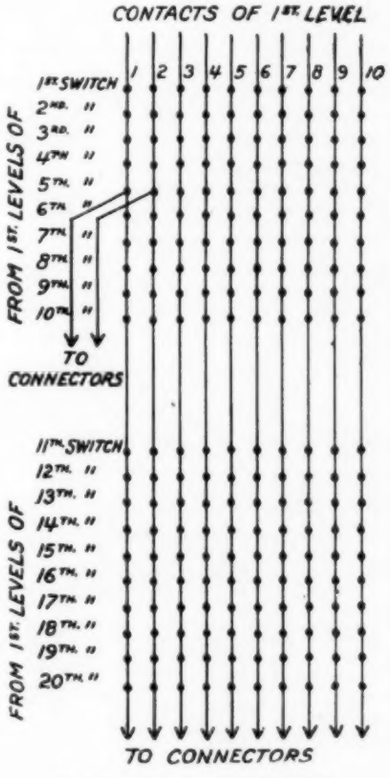


Fig. 9. Grading the Multiple.

in a group and increases the possibility of finding idle trunks on earlier contacts, but it does not increase the efficiency of the trunkgroups itself as the number of trunks accessible to a hundred subscribers remains ten. The efficiency may, however, be increased by arranging the wiring between the multiples, that is, between the groups of ten switch each, so that more than ten trunks are accessible to hundred subscribers. This can be obtained by grading the multiple.

Grading the Multiple

"Grading the multiple" means to arrange the multiple wiring so that earlier trunks are multiplied over fewer contacts than the later trunks, whereby the trunkgroups may be increased.

In Fig. 9 the two connecting racks are repetitions of the connecting rack in Fig. 8A as far as the arrangement of the terminals and their connection is concerned with the exception that the two lines joining the contacts 1 and 2 of the first level are cut after the multiple from the fifth switch and brought out to two new connectors, while the part of the lines behind the cut are left untouched; thereby the number of trunks accessible to the hundred subscribers served by the particular groupswitch multiple is increased to twelve.

The trunks through the contacts 1 and 2 of the first level of switches 6, 7, 8, 9 and 10 after the cut will not branch any more into the banks of hundred groupswitches but of fifty only, while the two new trunks come from the banks of the remaining fifty.

A very instructive example of multiple grading was given by Mr. A. Kruckow.* Fig. 10 shows how 12 groups of 10 incoming trunks each are transformed into a group of 40 outgoing trunks. This arrangement suffices to assure an economical utilization of groups under average load conditions.

It is not only groupswitches that invite to grading the multiple. Grading as well as slipping of the multiple may be applied with equal advantage to line switches.

To both, line and group switches, a combination of slipping and grading may be a great help in operation and prove economical at the same time.

In Fig. 11 a combination of slipping and grading the multiple in the primary lineswitches is illustrated. In addition cognizance is taken of the fact that the three first contacts in each level of a switch, whose wiper starts from normal position with each new call, carry the bulk of the traffic and consequently may be connected directly to groupswitches, while the remaining contacts carrying less traffic with progressive distance from the first contacts are extended to the groupswitches through secondary

lineswitches, the multiple in the primary lineswitches being accommodated to the usage of the contacts. In this way there may be accomplished a saving in switches without in any way restricting the free passage of calls.

To obtain very large trunkgroups intermediate switches which may be termed distributor switches are often employed. Such switches are constructively identical with lineswitches and may be equipped with from 10 to 25 contact sets. Distributor switches are inserted behind the rotating motion of the groupswitches; thusly the group of ten trunks is changed into a 100-group by employing distributor switches with 10 contact sets. The possible combinations that may be accomplished to increase trunk groups are innumerable and it is left to the ingenuity of the engineer to find the one which suits best his particular problem.

---

*Telegraphen— & Fernsprechtechnik. 1924. No. 5.

As an illustration how the ordinary trunkgroup of 10 may be improved a set of curves is presented which were produced by Mr. Langer. These curves Fig. 12, indicate how a trunkline may be improved by utilization of all the means discussed in the foregoing pages.

Effect of Sub-Offices

Trunkgrouping plays a prominent role in a telephone plant with *suboffices*. In manual practice a division of an exchange system into several offices takes place as a rule whenever the number of subscribers exceeds 10,000. In automatic practice this may be followed. However, the circumstance that the apparatus required in an automatic multi-office system will not differ in quantity (except for slight modifications) from the requirement for a single office, it being only a question whether the increased cost of trunkmileage overbalances the additional cost of subscribers' line mileage with a single office. This speaks in favor of early decentralization. The cost of manual B-sections and their operation requiring no balancing in automatic multi-office operation gives still further weight to decentralization.

It is known from manual practice that in very large exchange systems sometimes the local traffic in an office reaches such proportions that it proves economical to discard the A-board multiple and trunk, also the originating calls for subscribers in the same office. A corrollary is found in the automatic operation, although in the opposite sense, namely when the local business is so small in comparison to the outgoing trunk business that it would be more economical not to complete the local calls in the originating office, but to trunk all calls to another office and then trunk the small number of local calls back to the originating office. This scheme has value only when economy in wire mileage favors the establishment of an additional office, which would not be of any great size, say with about 500 lines, certainly not with more than 1,000. Such an office could be properly designated a sub office. Thus for distinction between automatic offices in a multi-office system the following three classes may be cited: 1. Main office. A main office is the largest office where the local business preponderates by far. There may be several main offices in an exchange district. 2. Branch office, where the quantitative difference between local and outgoing trunk traffic is not so pronounced. 3. Sub office, where the local business is less than the outgoing business.

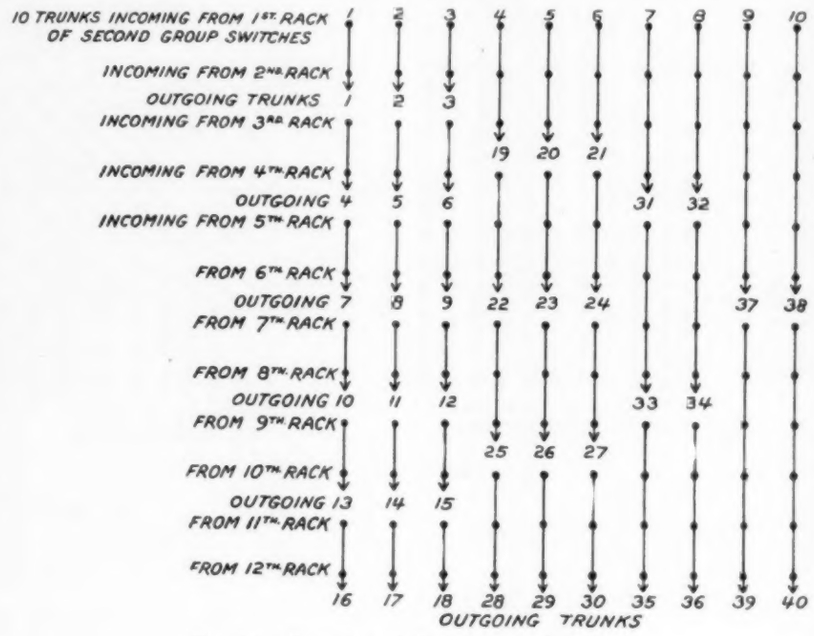


Fig. 10. Example of Grading the Multiple.

A branch office completes all local calls the same as the main office without trunking to other offices. Sub offices *may* trunk all calls to other offices, the local calls going to the nearest office, which may be a branch or a main office. In such a case the sub office will not have any first groupswitches, they are then located at the other offices. Therefore the number of switches to be maintained and supervised is considerably reduced, and as the size of the sub office is so small supervision can be arranged for at the branch or main office, where the local calls are trunked. The wire chief at the nearest office can also start and stop the charging of the storage battery and can make the routine test of the switches from his desk or testboard so that no personnel is required at the sub-office, occasional visits of an inspector being sufficient.

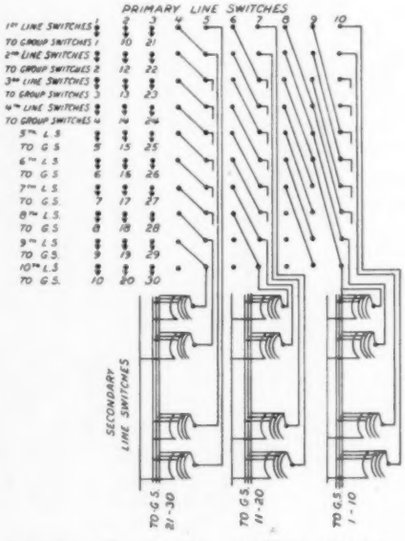


Fig. 11. Combination Multiple Wiring.

Above it was said intentionally: "Sub-offices *may* trunk all calls to other offices"; this, however, is not obligatory. In the October, 1923, issue of the TELEPHONE ENGINEER an arrangement was described for the completion of local calls in the originating office by means of companion switches. The subscriber calls as usual and connects himself through primary and secondary line switch to the first groupswitch in the nearest main or branch office. This groupswitch as well as the companion switch associated with the trunk at the sub-office are stopped simultaneously by the subscriber dialing. In case of a local call the secondary line switch will be reversed and started anew. It frees the trunk to the nearest office and connects to an idle local switch.

Who owns the telephone?

For seven carefree years young John Graves worked in the car shops at Orenville, spending his dollars as fast as he earned them. Soon after his promotion to foreman, he was married and moved to a little white house on Orchard Avenue. Life was happier than ever, but spare dollars were not more plentiful, especially after a third member was added to the family.

Then came a day when the plant superintendent showed John the wisdom of saving a part of his earnings, for the satisfaction it would bring, and for protection against emergencies and old age. He and his young wife, for the first time, learned the difficult art of economy, and finally they came to know the joys of saving and of safe investment.

Today John Graves, and many thousands like him, own the stock of the American Telephone and Telegraph Company. This company is owned by more people than any other, and the great majority of its owners —laborers, clerks, housewives, business men and others—have bought it with their savings. As its business has grown, the number of its shareholders has increased until now one out of every 45 telephone subscribers is also a stockholder.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
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When Sub-Office Should Be Installed

The determining factors whether the installations of a sub-office is warranted or whether branch office would be better, are (1) Percentage of outgoing trunking; (2) trunk wire mileage; the sub-office requires additional trunks to carry the local calls to and fro; the annual expense on these extra trunks must be offset by the expense for companion switches and by the saving on extra help and quarters at the sub-office; (3) rent; it is much easier to find a place for a sub-office than for a branch office as no attention need to be paid to environment, the sub-office can be located at a spot useless for other commercial purposes.

In working out the grouping of trunk lines the aim is to obtain the largest possible groups. For this purpose the sub-office at the outer edge of the plant are selected for a start and the work is prosecuted towards the center where the largest offices with the highest traffic are located. It is presupposed that the plant under consideration has been and still is operated manually and is to be transformed to automatic operation.

In most instances a study will indicate that the old offices can be retained, as they were established originally at such places, where the subscriber's distribution was nearest; therefore, these old offices will become main or branch offices in the automatic layout, and perhaps small or existing offices may serve as sub-offices. Fortunately the net of an automatic installation is extremely flexible and can easily be accommodated to operation and traffic conditions. So for instance an office building which would be too small for manual extension on account of the impossibility of extending a multiple board on another floor in case the old board is close to the wall can be made use of for an automatic equipment of any size by adding more floors, while an extension of a multiple board would require more space laterally. Switches can be distributed over several floors, as long as the switches in a class are kept together.

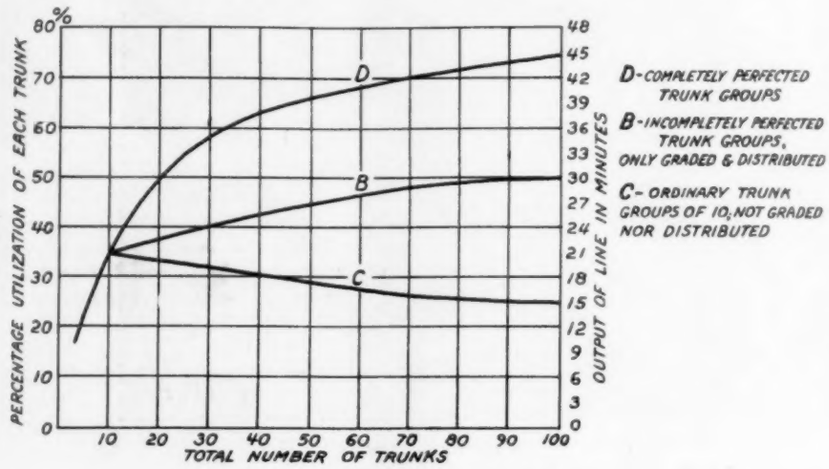


Fig. 12. Utilization of Trunk Lines.

If therefore the old offices are used as main or branch offices and sub-offices are located on such places where new spots of density of telephone population have developed the grouping of the trunk lines is taken in hand. The traffic study gives the number of trunks required between the offices.

In manual operation offices belonging to a multi-offices system are connected by direct trunk lines; it is an exception when a call is trunked through several offices in tandem, which is poor practice as the cable has then to be handled by more than two operators. In automatic operation no such restrictions exist, a call can pass through a series of offices in tandem, without in any way deteriorating the service. Sub-offices send their calls to the nearest branch or main office where they come in at the first group-switches. Local sub-office calls are trunked back. Calls for subscribers at this particular branch or main office go to second groupswitches in the same office and thence through connectors to the called party. Calls for subscribers of any other office go from the first groupswitches mentioned to second group-switches in the other offices using any idle trunk in the group between the branch or main office and the desired office, thereby enlarging the traffic over these trunks to good advantage.

In such installations and more so in larger ones where third groupswitches are required a call may pass through a number of offices and thus over trunk lines to which several offices have access. The larger these trunk groups can be made the more economical the plant. Not only a saving is made on trunk lines, but also on switches.

Trunking Scheme with Sub-Office

In Fig. 13 a skeleton diagram of a trunk system between a sub-office and a branch office is given. The branch office is supposed to belong to a 4-figure plant and the sub-office to be a 1000-line equipment. After all that has been said the arrangement should not need any further explanation, only attention may be called to the repeaters inserted in the trunk lines going out from the sub-office. A repeater is a combination of relays in the outgoing trunk circuit with three objects in view: 1. To repeat the impulses sent by the calling subscriber. 2. To provide the calling subscriber with talking battery from his own office; if this would not be done, the transmission would become unbalanced, as the called subscriber would be supplied with talking current from his connector at short range, while the connection from calling subscriber to battery at the distant office without the

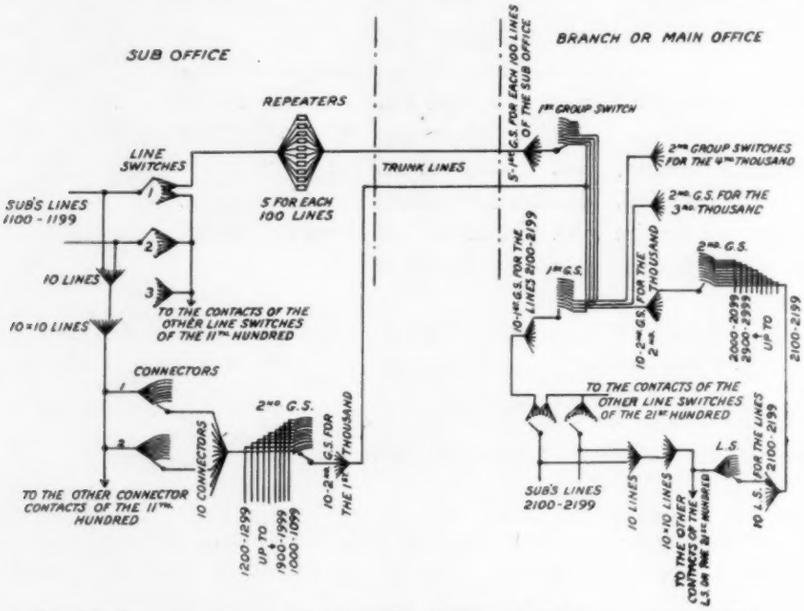

SUB OFFICE
BRANCH OR MAIN OFFICE
REPEATERS
LINE SWITCHES
TRUNK LINES
SUB'S LINES 1100 - 1199
5 FOR EACH 100 LINES
10 LINES
10 × 10 LINES
TO THE CONTACTS OF THE OTHER LINE SWITCHES OF THE 11TH HUNDRED
CONNECTORS
TO THE OTHER CONNECTOR CONTACTS OF THE 11TH HUNDRED
10 CONNECTORS
2ND G.S.
1200-1299 UP TO 1900-1999 1000-1099
10-2ND G.S. FOR THE 1ST THOUSAND
5TH G.S. FOR EACH 100 LINES OF THE SUB OFFICE
1ST GROUP SWITCH
2ND GROUP SWITCHES FOR THE 4TH THOUSAND
2ND G.S. FOR THE 3RD THOUSAND
2ND G.S.
1ST G.S.
10-1ST G.S. FOR THE LINES 2100-2199
10-2ND G.S. FOR THE 2ND THOUSAND
2000-2099 2900-2999 UP TO 2100-2199
TO THE CONTACTS OF THE OTHER LINE SWITCHES OF THE 21ST HUNDRED
L.S.
SUB'S LINES 2100-2199
10 LINES
10 × 10 LINES
TO THE OTHER CONTACTS OF THE L.S. IN THE 21ST HUNDRED
10 L.S. FOR THE LINES 2100-2199

Fig. 13. Trunking System Between Sub-Office and Branch or Main Office.

"IF YOU WEREN'T SUCH A BOOB, YOU'D'A HAD **RELIABLE** SAW-TOOTH ARRESTERS PUT ON THIS LINE IN THE FIRST PLACE."

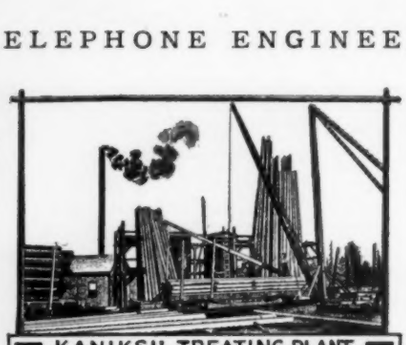
[To avoid such distressing incidents have your lines equipped by]
[Reliable Electric Co., 3145 Carroll Ave., Chicago]

interposition of a repeater may be very long. 3. To permit the use of two-wire trunks; the repeater maintains the switches at the originating office by grounding the release trunk (private wire).

The subscriber of a branch office calling for another office must also be supplied with battery from a local service. In the figure the assumption is made that of the 10,000 lines in the entire system the lines 1000 to 1999 are allotted to this particular sub-office. Of the other lines the lines 2000 to 2999 are shown as local lines at the branch office or main office as the case may be.

A call from a sub-office subscriber passes through a line switch and repeater over an outgoing trunk to a first groupswitch at the branch office, whence, if it is for a branch office subscriber, it finds its way to the proper second groupswitch, connector and called subscriber. If the call is for a subscriber of any other exchange, the first digit to be dialed will be higher than 2 and therefore the call passes from the first groupswitch at the branch office to a second groupswitch at the office where the 1000 subscribers corresponding to the first digit are located.

It would now be in place to say something about trunk grouping in very large exchange systems with 100,000 subscribers and more. As this involves features which demand a more extensive explanation and also lead to a discussion of automatic systems with power-driven switches, this subject will be reserved for a later occasion.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"Meet the Wife"—She's Official of "Sooner" Ass'n, Too

Sulphur, Okla.—Here's a real telephone family, the Crawfords of Sulphur. Frank, the nominal head of the family, was elected president of the Third District telephone division of the Oklahoma Utilities Association, and his wife was elected secretary of the division at the recent highly successful meeting of the organization.

Cotton Plant, Ark.—Approximately $30,000 has been spent in rehabilitation of the Cotton Plant telephone system.

Traer, Ia.—R. L. Parker remains with the new owners of the Mutual Telephone company as general manager of the recently effected Iowa consolidation.

Lawrence, Kan.—Kansas Telephone Company is spending $30,000 in improvements here.

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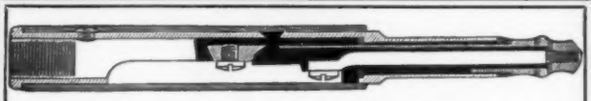
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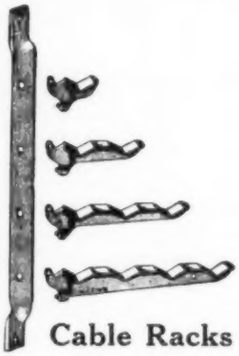

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LINE AND DESK

THE SLIDE WIRE BRIDGE

To the trouble shooter who may be stationed at some distant or out of the way exchange, and who in all probability is not supplied with efficient measuring apparatus, the slide wire or meter bridge is the most useful and yet inexpensive piece of apparatus which can be used for measuring purposes.

Its use does not require long study as is the case with the Wheatstone bridge. Short circuits, grounds and opens on line wires or cables can be measured just as

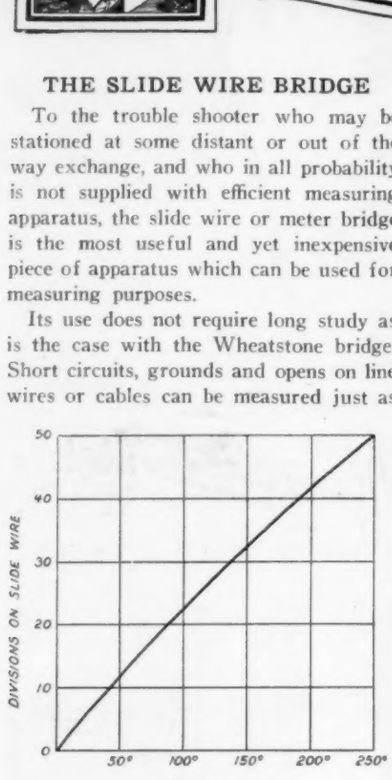


Fig. 3.

accurately as with the most expensive measuring instruments.

Several times when our exchange has been cut off from the outside world owing to severe storms, especially in winter, the slide wire bridge has been my only method of locating troubles and has amply repaid me for my labor in installing it.

The slide wire bridge which I am now using is mounted on a piece of wood 52 inches long, 2 inches wide and ¼ inch deep on which is marked off a scale of 100 divisions ½ inch apart (total 50 inches). At each end of scale is fastened two posts, between which is stretched a uniform piece of ordinary resistance wire. From each post a wire runs to a galvanometer and also two flexible cords to be used for connecting slide wire to lines as shown in diagram No. 1. A darning needle is soldered to a flexible cord to which is attached a bank of 20 dry cells connected in series to ground.

The slide wire is now ready for use. so let us proceed to measure a grounded line which in this case we shall say is a pair of wires in a cable, one of which is grounded, its mate being in good condition. First put a short circuit on distant end of cable, connect the two flexible cords to the pair in cable to be measured. then commence to tap needle along the slide wire until a point is reached where there is no deflection on galvanometer. This is the point of balance.

Example: Cable is 1,000 feet long, consequently the pair of wires, one of which is grounded, will form a loop of 2,000 feet.

The point of balance on the slide wire is found to be 34 divisions. The total number of divisions on slide wire is 100.

Therefore $\frac{2{,}000 \times 34}{100} = 34$

$34 \times 2{,}000 = 68000 \div 100 = 680$ feet to trouble.

In order to convert the slide wire bridge into an ohm-meter all that is necessary is to insert resistance coil of any desired value into one arm of the bridge. It will also be necessary to move the flexible cord from the end of slide wire to the outside end of resistance coil, also move the battery connection to the outside of resistance coil. By placing two switches as shown in diagram No. 2 these change-overs can be quickly made from the ground test to the ohm-meter.

In this case the easiest way to find out the unknown resistance is to take a sheet of graph paper, measure a few coils of known resistance and mark on graph the various positions of the different resistances, then fill in the curve of resistance on graph paper as shown on diagram No. 3.—*Contributed.*

N. B.—500 ohm coil in bridge arm.

WHERE TWISTED PAIR WOULD NOT WORK

A few days ago after a heavy windstorm, a subscriber on one of our country lines reported that a branch of a tree had been blown off and that the drop wire was broken down. They had connected it again, but still the line did not work. A test showed the line short and when I went out on it I found that the drop had been spliced out with about ten feet of twisted steel fence wire, with each wire of the twisted pair drop carefully connected to one of the wires of the twisted fence wire. The subscriber had used twisted pair in his repairs all right, but some way or other the rust on the fence wire was not sufficient insulation and the line was short.

—Contributed by C. R. Abdon.

Plan Correspondence Course Based on Toll Books

Chicago, Ill.—In releasing a number of new pages for the Toll Reference and Text Book published by the United States Independent Telephone association, the organization says:

"We plan soon to issue a correspondence course based on this book. We hope that all of your toll operators will feel interested in this course and desire to take it. It will be a worthwhile effort for every toll operator who desires to improve her work and who is ambitious to fit herself for greater responsibility."

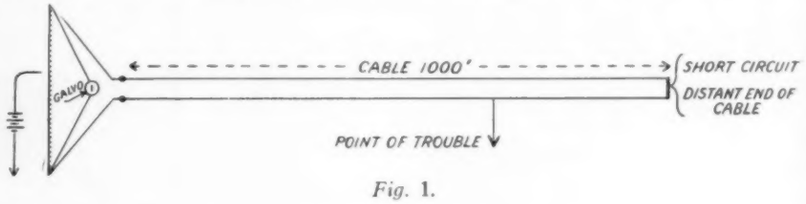


Fig. 1.

New York Spends Thirty Million in Six Months

New York.—The directors of the New York Telephone Co. have authorized the additional expenditure of $1,000,000 for new construction. This brings the total of appropriations made during the first six months of 1925 to $30,233,265, of which $25,871,220 was for enlargement of plant facilities in the Metropolitan area.

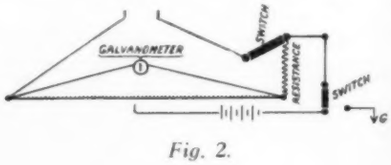


Fig. 2.

(Continued from page 26.)

Use of Insulated Joints

Early in this article, the writer mentioned the insulated joint as a possible remedy for localizing electrolysis. This is frequently necessary at bridges (Fig. 8) and under similar conditions and, as has been said, it has been proposed for entire systems. Such an insulating joint (Fig. 9) would have a tendency to break up the destructive currents going

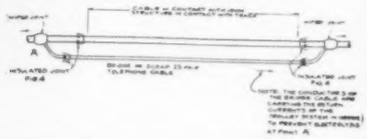
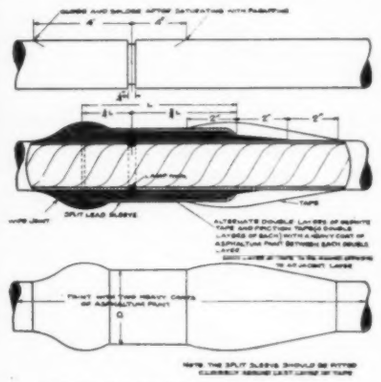


Fig. 8. Using Insulated Points to Insulate Section of Sheath.

in the cables. Even though the ducts were very damp and the section of cable laid in the duct, the cable would be exposed to a very small potential for that distance and even with a very badly bonded railway system. The average bonded railway permits a drop of ten volts to the mile. The average cable section is approximately four hundred feet; hence only 1/13 of that amount of drop. Lying in the ducts, which are always some distance from the track, the resistance of the combination might prevent any flow of current and as the



Values of "L" and "D" for Different Cables.

SIZE OF CABLE	L	D	SIZE OF CABLE	L	D
25 pr. 16 ga.	10"	2½"	150 pr. 19 ga.	8"	2½"
50 pr. 22 ga.	8"	2"	150 pr. 16 ga.	10"	3½"
50 pr. 19 ga.	8"	2½"	200 pr. 22 ga.	8"	2½"
50 pr. 16 ga.	8"	2½"	200 pr. 19 ga.	10"	3"
50 pr. 14 ga.	8"	3"	300 pr. 22 ga.	10"	3"
75 pr. 14 ga.	10"	3"	300 pr. 19 ga.	10"	3½"
100 pr. 22 ga.	8"	2"	400 pr. 22 ga.	10"	3½"
100 pr. 19 ga.	10"	3"	600 pr. 22 ga.	10"	3½"
125 pr. 14 ga.	10"	3½"			

Fig. 9.

cable is touching the damp duct its entire length, a small difference in potential would find difficulty in existence under these conditions.

Return Feeder Must Not Be Too Large

In providing a return feeder from the cable system to the power house care must be taken not to have the feeder too large. If its resistance is too low in comparison to the resistance of the rail path, the stray currents will be invited to return over the cable sheath and there is a possibility that the current may be so large that the carrying capacity of the cable sheath may be exceeded and damage from overheating may result. A safe plan is to make current readings in the return feeder to make sure that the current is not too large.

FOR SALE

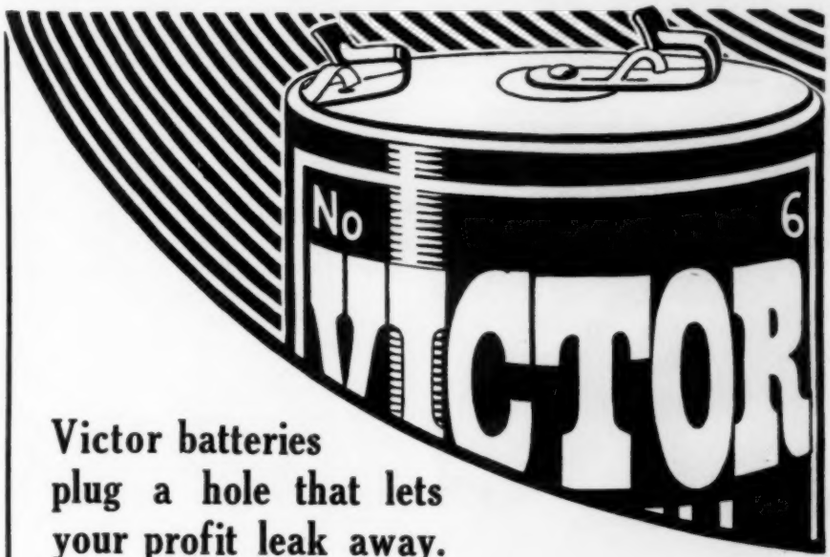
15 miles of new No. 12 Double Braid Weatherproof Iron Wire in ½-mile coils, at 6c per pound.

Queen City Electric Company
1734 Grand Avenue Chicago, Illinois

Tecumseh, Okla.—A new $25,000 home is being built for the Tecumseh Telephone Company.

New Philadelphia, Ohio—Stockholders of the Tuscarawas County Telephone Company have approved plan to install automatc equipment. Name of the corporation is to be changed to the Ohio Cities Telephone Company.

Tahoka, Tex.—Considerable work is to be done in betterment of the Tahoka telephone system, according to W. M. Harris, owner.



Victor batteries plug a hole that lets your profit leak away.

Experts have estimated that 6% of the average magneto telephone income is dry battery expense.

Use of Victor batteries makes a sharp reduction in this cost. There are plenty of cases where Victor cells have given good telephone service for two years, and then been replaced only because the manager was getting nervous from this uncanny long battery life.

It's not just luck that is responsible for Victor longer life. This battery is the masterpiece of the brilliant career of the dean of the dry battery profession.

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THE CARBON PRODUCTS CO.
LANCASTER, OHIO

TRAFFIC CONDITIONS IN THE PHILIPPINES.

By Ray Blain

When looking over things of telephone interest in Manila I chanced upon the peculiar PBX shown in the accompanying photograph. This board was operated by male Filipinos and the dignified old fellow standing informed me that he was Chief Operator. I also found that he was trouble shooter and installer and that he did very good work. The switchboard was a common battery using a mechanical signal instead of lamps. I found the board worked very good except that its arrangement would not permit very speedy service should the operators get very busy. The board was built here in the islands by Filipinos using mostly standard parts of American

P. B. X. Board in the Philippines.

manufacture. The cabinet was built of native hard wood known as red narrow and was very attractive.

I asked the Chief Operator how long he had been doing telephone work and he answered since 1898. I then said, I suppose that you will soon retire on a pension, he shook his head sadly and said "No I can't retire as I am still a temporary employe." This is the first time I have ever heard of anyone being a temporary employe for nearly 27 years. I don't expect that he would have ever considered the position in the first place had he known that it was only temporary.

At the time I entered the office the Chief Operator was very laboriously answering a traffic complaint of which I was able to obtain a copy, which is as follows except names are fictitious.

"Honorable Sir:

"According with the report from the Construction Division, directed to Traffic Superintendent, dated Jan. 5, 1925, which the Chief Telephone Operator received at 10:50 a. m., Jan. 7, 1925. Telephone operators they said, they know that Mr. Brown is not any more in the construction, and further that telephone calls for Mr. Brown was daily connected with the phone in the construction Division Local No. 59. The telephone operator said, they do not remember if they have connected the calls for Mr. Brown in the Construction Division. They told me, if the parties call on telephone for Mr. Brown, by name telephone operator do not make mistake, because they know what telephone they can get Mr. Brown, that is in telephone Local No. 12, Storekeepers Office, and if he is not in that phone they can get him in phone No. 461 storeroom. Maybe the parties that call Mr. Brown, ask the operator for Construction Division or No. 59, so the operator connect them in that office. More better parties ask for Mr. Brown, not number and operator not make mistake."

Very respectfully,

Sgd. Perfecto De La Cruz,

Chief Telephone Operator.

The party making the complaint after receiving the above letter said he guessed it was all right. If you make a complaint against a Filipino and let him answer it in writing you don't have a Chinaman's chance.

P. Kerr Higgins in Full Highlander regalia. This popular writer now is traveling in Europe, studying foreign telephone practices and problems.

CODE OF ETHICS

of

California Independent Telephone Association.

Adopted April 24, 1925.

Recognizing the importance, universality, and intimate association of our industry with the lives and business of our country, we who direct the policies of our business, believing that we should encourage and foster high ethical standards, do hereby adopt this Code of Ethics for our guidance and inspiration.

This Code of Ethics is predicated upon the basic principles of truth and honesty, for which we in all our relations shall ever strive.

In particular,

1. FOR OUR PATRONS—We acknowledge our obligation as a public enterprise to give uniform, impartial, efficient, courteous, and satisfactory service, cooperating with public regulatory bodies to accomplish these results expecting to give and receive fair dealing and mutual benefit, basing our rates upon a reasonable return.

2. FOR OUR EMPLOYEES—We recognize that team-work is essential and that it is our duty to instruct, assist, encourage, adequately compensate, and recognize the humanity of those who labor with us.

3. FOR THOSE FROM WHOM WE BUY—Co-operation, good-will and mutual gain will be sought, giving preference to those who uphold ethical business standards.

4. FOR OUR NEIGHBOR IN BUSINESS—As business men it is a real duty to support the associations that have been organized for the sake of the industry. We will seek to maintain the most friendly and cordial relations with the management and employes of the Long Distance and other connecting companies.

5. FOR THE COMMUNITY IN WHICH WE LIVE—We assume a responsibility as citizens and public servants, to take an active interest in the welfare of our community by supporting the agencies which have the public welfare as their object.

6. FOR OUR GOVERNMENT—We desire to promote the respect for the law and for the regulatory and law-making bodies. We will not seek to embarrass them or weaken this respect, but will assume responsibility for rates and practices for which we have applied, and which have been authorized.

7. FOR THE FUTURE—We will contend for the progress of our industry and the benefit of mankind, aiming towards that ideal "The Practice of the Golden Rule."

(Condensed from the Code of Ethics of the United States Independent Telephone Association, adopted October 26, 1923.)

George A. Scoville Heads Radio Group

George A. Scoville, vice president and general sales manager of Stromberg-Carlson Telephone Manufacturing Company has been named chairman of the

George A. Scoville

Radio Apparatus section of the Associated Manufacturers of Electrical Supplies.

This signal recognition of Mr. Scoville's fitness, coming as it does, from the leading makers of receiving sets, parts and accessories, is good news to the telephone fraternity throughout which Mr. Scoville is known as one of its very able and successful performers.

Newark, N. J.—Public Service Corporation of New Jersey is to have the largest private telephone system in the world, comprising approximately 1,200 miles of wire, when present extension work is completed.

New York City—International Telephone and Telegraph Company has acquired a substantial interest in the Compagnie des Telephones Thomson-Houston, a French telephone manufacturing company.

Iowa City, Ia.—An improvement campaign involving $50,000 has been begun at Iowa City.

FOR SALE—One hundred second-hand Baird & Delta Lock Out Attachments in good condition. Price twenty-five cents (25c) each f. o. b. Vernon, B. C., Canada. Address Okanagan Telo. Co., Vernon, B. C., Canada.

More N. Y.-Chicago Cable

Bell Puts Cleveland-Toledo Section Into Service — Entire Line Soon

New York City—With the completion of the Toledo-Cleveland section of the Chicago-New York Bell cable, only two more sections remain to be constructed before the entire line is completed. It is expected that the remaining work will take about five months.

Sections of the line previously completed are those from Chicago to South Bend, South Bend to Toledo, and Cleveland to New Castle, Pa.

Construction of the line began in 1923 as part of the A. T. and T. plan to care for the increasing wire load and to protect against storm damage. Southern yellow pine poles, pressured creosoted with 12 lbs. of creosote per cubic foot according to Bell specifications are used. Class B pine poles, mostly 22 ft. and 25 ft. are used, with the exception of larger poles for grade crossing and other places where service conditions dictate.

Some interesting details of the Cleveland-Toledo section were presented by W. K. Migrath in a recent issue of Long Lines. Mr. Migrath said:

"Some very interesting problems were encountered in connection with determining the best route from Cleveland to Toledo. The objectives were to obtain the shortest possible route, free from inductive interference or hazards from power lines, with the least amount of underground construction and passing through a locality suitable for an intermediate repeater station. All of these conditions were met, which speaks well for those responsible for this part of the work.

"Serious consideration was at one time given to the idea of routing the line across Sandusky Bay, using right-of-way of the New York Central Railroad and a series of submarine cables for the section where the railroad crosses the bay proper (a distance of about four miles) and constructing the line adjacent to their right-of-way through the swamp land bordering the bay. This scheme was abandoned for various reasons.

"Our success in securing the shortest possible route from Central Office Cleveland to Central Office Toledo, notwithstanding the fact that it was necessary to skirt around to the South of Sandusky Bay and its swamps, is indicated by a comparison with the length of the New York Central route. Our cable line totals 109.37 miles, while the railroad covers 113 miles. To secure this short route it was necessary to purchase rights-of-way across private property for a total distance of 40.5 miles.

"The length of the various types of construction are as follows:

"Pole line, class B creosoted pine poles spaced 110 feet—91 miles; underground conduit—existing conduit at Cleveland and Toledo—10 miles; new conduit at eight different points, including additional conduit entering Cleveland and Toledo—8 miles; submarine cables—four—.37 miles; total—109.37 miles.

"Four submarine cables were required to cross streams that are classed as navigable and controlled by the War Department.

"The High Level Bridge at Cleveland was used in crossing the Cuyahoga River, another navigable stream.

Vermillion River Crossing Cleveland-Toledo Cable.

"Long span crossings 250 feet in length were found necessary in crossing the Black and Vermillion Rivers and also Mud Creek, located near Huron, Ohio. At the points where the cable line crosses the Black and Vermillion Rivers these gorges are approximately 100 feet deep and required special construction methods in crossing. In one instance, in making the descent into one of these gorges, the cable was carried from the top of a twenty foot pole at the top of the bluff to the top of a fifty-five foot pole set in the side of the bluff, making a vertical run down this pole for a distance of thirty-seven feet to a point ten feet above the ground. Thence it was carried to the top of another fifty-five

foot pole and from there to the terminal pole of a long span fixture."

Ingenious Swamp Crossing.

"The crossing of a swamp adjacent to the Huron River for a distance of nearly one-half mile presented a problem that had to be carefully considered. A pole line could have been constructed across this swamp by using special swamp fixture construction. But it was learned that the heavy growth of vegetation or rushes was burned off each fall by hunters or trappers to facilitate their trapping operations. These fires made it impracticable to try to maintain an aerial line, so underground construction was decided upon.

"When making soundings to determine the extent of special work that would be necessary in constructing the underground conduit, it was found that the swamp had no solid ground underneath for a depth of from ten to twelve feet, the entire surface being unstable and shaky. It was then decided to build the conduit on the surface, letting it gradually settle if it would do so.

"A plank walk sixteen inches wide was

Toledo-Cleveland Long Span Crossing at Vermillion.

laid on suitable cross pieces across the swamp and in the location desired for the conduit. This walk was used to wheel construction materials out to the points needed, and the work started at the far end. The conduit, completely encased in concrete and reinforced with several strands of 6000-pound messenger, was laid on this walk. Manholes with only three feet head-room were constructed, tied to the conduit by means of the reinforcing strands so that there could not be any abrupt settling of anv part of the conduit system. On completion it was found that the weight of the conduit had caused the planking to settle a few inches so that it was completely submerged in the surface water, which was desirable. No appreciable settling has been noted and it is felt that we have a perfectly safe route over the swamp.

"This cable was planned jointly with the Ohio Bell company to meet the combined requirements of the two companies. The cable contains forty-two quads of sixteen gauge conductors and seventy-six quads of nineteen gauge conductors. When all conductors are in service it will provide about 300 telephone, and as many telegraph, circuits. Loading coils were installed with the cable on thirty-five quads of conductors."

Still True to the First Love

In 1953 John T. Barrett will celebrate his fiftieth anniversary of service with Stromberg-Carlson. That is, if John doesn't get too close to disaster when he is enjoying his favorite hobby of following the clanging wagons to fires, for

Barrett is a fire fan of the same class as a grammar school youngster.

Barrett's first job was with Stromberg-Carlson, having entered the employ of the Rochester company as a timekeeper in 1903.

After ten years' work at the plant he went on the road as New York state representative, and has, like Johnny Walker of reminiscent fame, been going strong ever since. Ever since birth Barrett has been close to the Stromberg-Carlson outfit, as he was born in Rochester. Being of a congenial nature, naturally Barrett has done his share of "j'ining," having among his society affiliations membership in the hustling tribe of the Caseys, the Pioneers, the Elks, the U. T. C. and automobile and golf clubs.

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Dean Elec. 3-bar 1000 or 1600 ohm Bdg. desk sets @ $8.75—4-bar $3.25—5-bar @	10.25
Stromberg Late type 3-bar 1000 or 1600 ohm Bdg. desk sets @ $10.00—4-bar $10.50—5-bar @	11.00
Kellogg Local or Common battery transmitters complete with backs and new mouthpieces @	1.10
Dean or Garford Latest type Brass cup receivers with new shells @	1.10
Western Elec. 2- or 3-bar No. 22 type Bdg. hand Generators complete with cranks, screws, etc., @	1.50
Dean or Garford 16-33-50 or 66 cycle harmonic ringers with gongs @	1.25
New Western Elec. No. 144 Receiver shells with caps, lots of 100 @	35.00
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Okahoma District in Brisk Sessions at Sulphur

Sulphur, Okla.—The conference and outing of the Third District, Telephone Division, Oklahoma Utilities Association, was the first two-day meeting in several years. Many telephone folks came from other districts in Oklahoma and some from Texas, Missouri and Kansas.

District Chairman L. E. Davis of Mill Creek presided, assisted by H. W. Hubenthal.

"Telephone Service from the User's Standpoint" was discussed by Judge W. G. Long of Sulphur, who paid a tribute to telephone operators generally, and to Frank Crawford, manager of the Sulphur Telephone Company; Fred B. Seem, Bartlesville, superintendent, The Empire companies' telephone and telegraph system; C. M. Tuggle, Roosevelt, manager National Telephone company, and H. W. Hubenthal, Oklahoma City, discussed the relation of radio to the telephone industry. A letter from George E. Goodhead, Goodhead Telephone company, Beggs, described recent installation and operation of wired radio by his company, the first in Oklahoma to use radio as a profitable by-product. Mr. Goodhead invites inquiries.

Discussion was had on switching rates and a differential charge for desk sets. Queries were answered and the importance of filing completed questionnaires was stressed. Out of 600 questionnaires mailed out by the Association to date only nine on switching service and 29 on desk set differential charges have been returned. Managers, especially those who furnish switching service, were urged to return questionnaires to aid representations to the Corporation Commission regarding a general order for an advance in switching rates and a differential charge for desk sets.

The Saturday session opened with "Observation of Telephone Service from the Public's Standpoint," by C. L. Owen, president, Sulphur Chamber of Commerce, and Sulphur manager of the Oklahoma Gas & Electric company. Plant inspection now made by the Southwestern Bell Telephone Company was explained by Jim Raulston, who conducts these tests and makes necessary recommendations for improvements and betterments for the mutual benefit of the Bell and Independent companies. Toll check error settlements and adjustment of uncollectable accounts prompted discussion. Many complained of delay. M. A. Sanders, connecting company agent, promised prompt adjustments of differences. J. P. Gibson, president Western Telephone company, also president, State Bankers' Association, urged co-operation between member companies in solving any problem.

Big Increase in Industry's Use of Copper and Brass

New York City—More than 1,290,000,000 copper and brass parts, weighing approximately 33,000,000 pounds, were in service last year in the nation's telephone instruments, according to figures compiled by the Copper and Brass Research Association. These figures refer merely to the familiar appliance into which the message is spoken and do not include wires or other telephone necessities.

Over two pounds of brass and copper, distributed in eighty individual parts, will be found in the ordinary telephone instrument. There are 21 copper and brass parts in the transmitter, 13 in the receiver, 21 in the cords and in the desk stand itself 25.

Consumption of brass and copper in telephone manufacture is increasing as the public's demand for telephone service is met. Although in 1920 copper and brass in the country's telephone instruments totaled approximately 1,066,000,000 parts, the latest computation discloses an increased consumption in four years in instruments alone of 230,320,000 copper and brass parts.

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Send for free sample and prices on
UNIVERSAL DROP WIRE INSULATORS
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120-A, S. 7th St., Terre Haute, Ind.

FOREMEN WERE THEIR OWN ENGINEERS IN THE OLD DAYS

Forty years ago we were struggling under the biggest job ever undertaken in pole line construction, before or since. We were building a forty-five and fifty foot pole line to carry a hundred wires between New York and Philadelphia. It was the first line built by the American Telephone and Telegraph Company.

The winter was severe, and all of us were new to such a big proposition. A few of us had gained some experience in the old telegraph companies. But it wasn't worth a great deal. Hard-drawn copper wire had just been invented and had to be handled very carefully. All our old methods of handling iron wire had to be discarded, and new ones worked out to fit the new conditions, for we were carrying twenty-six copper wires and a number six iron wire on top of the poles. This was known as the backbone of the line. But it would stretch about fifteen per cent. before breaking, whereas our hard-drawn copper wire would elongate only about one per cent, before it broke.

How to allow for these differences was only one of a succession of difficult questions that had to be answered by the foremen or a member of their gangs. In some way or other, all were worked out. Most of the methods devised were so satisfactory that they were later incorporated in specifications that are in use today.

To show you what we were up against, let me explain how we manufactured our own guys. A barrel head was reinforced and fastened so that it would turn like a wheel. Four holes were bored in it, through which were fastened the ends of four strands of number six iron wire. The wire was stretched taut, and the other ends anchored and fastened together. Then the barrel head was turned by hand, like the steering-wheel of a vessel, until a four strand wire rope had been laid up. It was surprising how efficient some of the men became at this work.

We even had to manufacture our own tie wire in those days, by annealing hard-drawn copper wire in fires we built beside the road. The practice of sending tie wire to the gangs along with the hard-drawn copper wire had not yet begun. We had to make use of odds and ends of wire, taking the temper out by heating them in this way.

One of the first of our important problems was the proper tie to be used to tie the wire to the insulator. W. H. Fairbank, our general superintendent of construction and a real old-timer, ordered us to use one which failed to work out to our satisfaction. Having had some experience as a climber, I took it upon myself to perfect a tie, for as foreman of one of the two gangs of the company I had my troubles tying the wires. Finally I worked out the tie that is in use today. An insulator was tied on a piece of wire set up for the purpose, and remained there for a year or more until its adoption and approval for the construction specification.

The "grip" for holding the hard-drawn wire while it was being pulled up seemed next in importance. All the old grips, eccentrics and appliances which had been used for iron wires were officially condemned on the ground that they bruised the copper wire. So we simply had to smuggle in and use some of the old methods in order to get the wires through, until we were able to devise new methods that would do the work satisfactorily. Meanwhile, the work went steadily on.

Jim Doyle, now general line foreman, division one, was the acting foreman of the other of the two gangs, the one that started from the Philadelphia end of the line at Haynesport, N. J. He and his men devised a grip which they called a banjo, and by that name it was known for as long as it was used. It consisted of a circular piece cut from a board, grooved all around the outer edge. A board was nailed on the back and an iron was attached with which to hook the block and fall. It surely did resemble the musical instrument for which it was named. Two or three turns of the line wire would be wound around the edge, in the groove, and a plug would be set in to hold the slack. This eliminated all possibilities of kinking and bruising the wires. The banjo was used for several years, until a more satisfactory grip for hard-drawn copper wire was devised.—A. S. Campbell in Long Lines.

Chandler New W. E. Manager of Memphis Sales

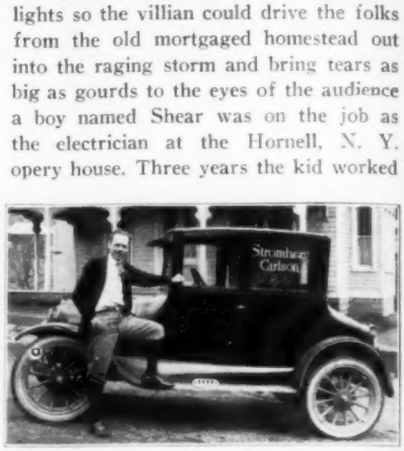
Memphis, Tenn.—O. B. Chandler has been appointed sales manager of the Western Electric supply distributing branch house here to succeed E. P. McGrath, who has been transferred to New York.

Big Development in Bell's Wire and Cable Plant

New York City—During 1924, there was an increase of 15.6 per cent of wire mileage in the outside plant of the Bell System—5,148,000 cable and 222,000 miles of open wire. At the end of 1924 89 per cent of the wire mileage of the Bell System was in cable and about three-quarters of the cable was underground.

He Learned How to Stage His "Stuff"

When the time came for dimming the lights so the villian could drive the folks from the old mortgaged homestead out into the raging storm and bring tears as big as gourds to the eyes of the audience a boy named Shear was on the job as the electrician at the Hornell, N. Y. opery house. Three years the kid worked



at this job and got a reputation locally for being able to do more stunts with footlights than a monkey could do on a mile of grape vine.

That, briefly is a record of the formative years of the business career of C. M. Shear who works the eastern New York and New England states beat for Stromberg-Carlson. The combination of electrical work and dramatic education Shear picked up during the early stages of his work have had their effect in preparing him for staging a sale where technical and human elements are niftily balanced.

Shear has had considerable and varied electrical and telephone experience. Prior to his connection with Stromberg-Carlson he was in the electrical construction business on his own hook at Buffalo and Corning, N. Y. He was manager of the Hammondsport, N. Y. Telephone exchange, night wire chief at the Stone exchange of the Rochester N. Y. Telephone corporation, and installer for Stromberg-Carlson at the new Glenwood exchange at Rochester before he took up his present run. So taking one consideration with another, Shear's lot was not an idle one.

He knows his beat from A to Z, having been born at Andover, N. Y., and as a boy travelled a good part of the territory he now works. Works is the right word, too, for outside of selling the S-C line he has but a few minutes out of the twenty-four hours to indulge in his hobby of radio research, to take a swim, or to talk it over with his worthy and well qualified brethren on lodge nights.

Tampico, Tamps, Mex.—Mexican Telephone and Telegraph company will spend approximately $2,000,000 in the state of Tamaulipas.

District Conferences Aid

Northwestern and Southwestern Independent A, B, and C Companies Meet

Chicago, Ill.—District conferences of the United States Independent Telephone association recently held at Des Moines, Kansas City and Dallas registered considerable progress in the ambition of the association to standardize accounting and financing operations of the member companies.

The meetings, presided over by President MacKinnon of the association, revealed some very interesting statistics. The results of operations of Class A, B and C companies in the southwestern district:

	1916	1924	Percentage Increase in Telephones
Perc'tage for int. and dividends..	7.2	8.4	1916-24- 25.8
Percentage for capital stock..	11.2	13.5	1922-23-(d) 2.8
Interest to funded debt	6.1	6.5	1923-24- 4.5
Depreciation to fixed capital....	3.6	5.3	

	Gain in Telephones in 1923-1924 Per Cent	Available for Interest and Dividends 1924 Per Cent	Depreciation Rate, 1924 Per Cent
A class companies.	8.3	7.5	5.2
B class companies.	4.7	9.8	5.3
C class companies.	2.7	5.1	5.5

A general comparative summary for 1916-1924 inclusive, for the A, B and C member companies ot the northwestern district, were given as follows:

	1916.	1922.	1923.	1924.	1916-1924. Increase.	1923-1924. Increase.
No. of central offices	364	371	372	375	11	3
No. of telephones	178,817	233,005	246,633	253,746	74,929	7,113
Toll wire mileage	.....	.....	†70,295	†77,227	.....	.....
Fixed capital	$22,927,031	$33,807,634	$35,324,009	$36,341,415	$13,414,384	$ 1,017,406
Total assets	25,898,377	38,515,420	39,885,507	41,195,039	15,296,662	1,309,532
Capital stock	16,199,508	21,239,591	21,391,544	21,621,363	5,421,855	229,819
Funded debt	4,758,842	8,439,950	8,414,100	8,514,900	3,756,058	25,600
Operating revenue	4,573,952	9,190,505	9,708,569	9,909,726	5,335,774	201,157
Depreciation	677,914	1,751,253	1,791,654	1,849,934	1,172,020	58,280
Current maintenance	791,986	1,462,240	1,714,805	1,694,397	902,411	*20,408
Traffic	823,132	1,931,881	1,942,191	1,911,139	1,088,007	*31,052
Commercial	434,478	627,589	650,223	637,808	203,330	*12,415
General and miscellaneous	314,890	556,624	512,178	502,803	187,913	*9,375
Total operating expenses	3,042,400	6,329,587	6,611,051	6,596,081	3,553,681	*14,970
Net operating revenue	1,531,552	2,860,918	3,097,518	3,313,645	1,782,093	216,127
All other revenue	.....	187,355	188,394	190,575	190,575	2,181
Taxes	167,738	540,901	620,628	719,193	551,455	98 565
Other deductions	99,186	289,617	306,479	285,976	186,790	*20,503
Total deductions	266,924	830,518	927,107	1,005,169	738,245	78,062
Income available for interest and dividends	1,264,628	2,217,755	2,358,805	2,499,051	1,234,423	140,246
Interest	219,419	405,665	481,929	489,555	270,136	7,626
Available for dividends	1,045,209	1,812,090	1,876,876	2,009,496	964,287	132,620
Percentages:						
Income available for interest and dividends to fixed capital	5.5	6.6	6.7	6.9		
Net income to capital stock	6.5	8.5	8.8	9.3		
Interest to funded debt	4.6	4.8	5.7	5.7		
Depreciation rate	..0	5.2	5.1	5.1		
Operating ratio	66.5	68.9	68.1	66.6		

Percentage of increase in No. of telephones	
1916-24	41.9
1922-23	6.0
1923-24	2.7

*Decrease. †Information not received from all companies.

In the concluding session were presented motion pictures demonstrating the manufacture of telephone machinery. Frank C. Paine, vice-president of the Union Trust company, spoke on "Tips on Financing." "Something My Telephone Experience Has Taught Me" was the subject of a talk by D. S. Wilkinson, Columbia River Telephone company.

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Washington Plans to Squeeze Out Phone Sponge

Spokane, Wash.—Details of the plan followed by the Interstate Utilities company in making the "telephone sponge" persona non grata were related at the annual convention of the Independent Telephone association of Washington by Miss Marjorie Smith of the Interstate organization.

Vice-President A. T. West presided at the sessions in the absence of President Edwin F. Keyes. Miss Carrie Lester, secretary of the Interstate Utilities company, spoke on the cost of rendering rural service.

The following officers were elected for the coming year: E. F. Keyes, Sunnyside, re-elected president; J. W. Baker, Spokane, re-elected secretary; P. W. Cornue, Selah, vice-president; E. Smith, Chewelah; E. C. Cole, Goldendale; George L. Gaines, North Bend; Mrs. Kate Glover, Concrete; C. O. Johnson, directors.

Commissioner Charles H. Hedger welcomed the visiting phone men and women, expressing his surprise at learning that there are 871 independent companies inside the organization, besides as many more not organized.

R. J. Worthman, Spokane, spoke on "Telephone Accounting," C. E. Munsell gave several pointers on plugging financial leaks "here and there about the plant." Munsell is with the Farmers' Telephone and Telegraph company of Wenatchee.

John King, Puyallup read a report on the national convention of Independent telephone men, held in Chicago in October, 1924, to which he was a delegate from Washington.

The first day closed with a banquet in the Davenport hotel.

Russell, Kan.—Central Telephone Company of Abilene, a subsidiary of the United Telephone Company, has bought the Russell Telephone Exchange.

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